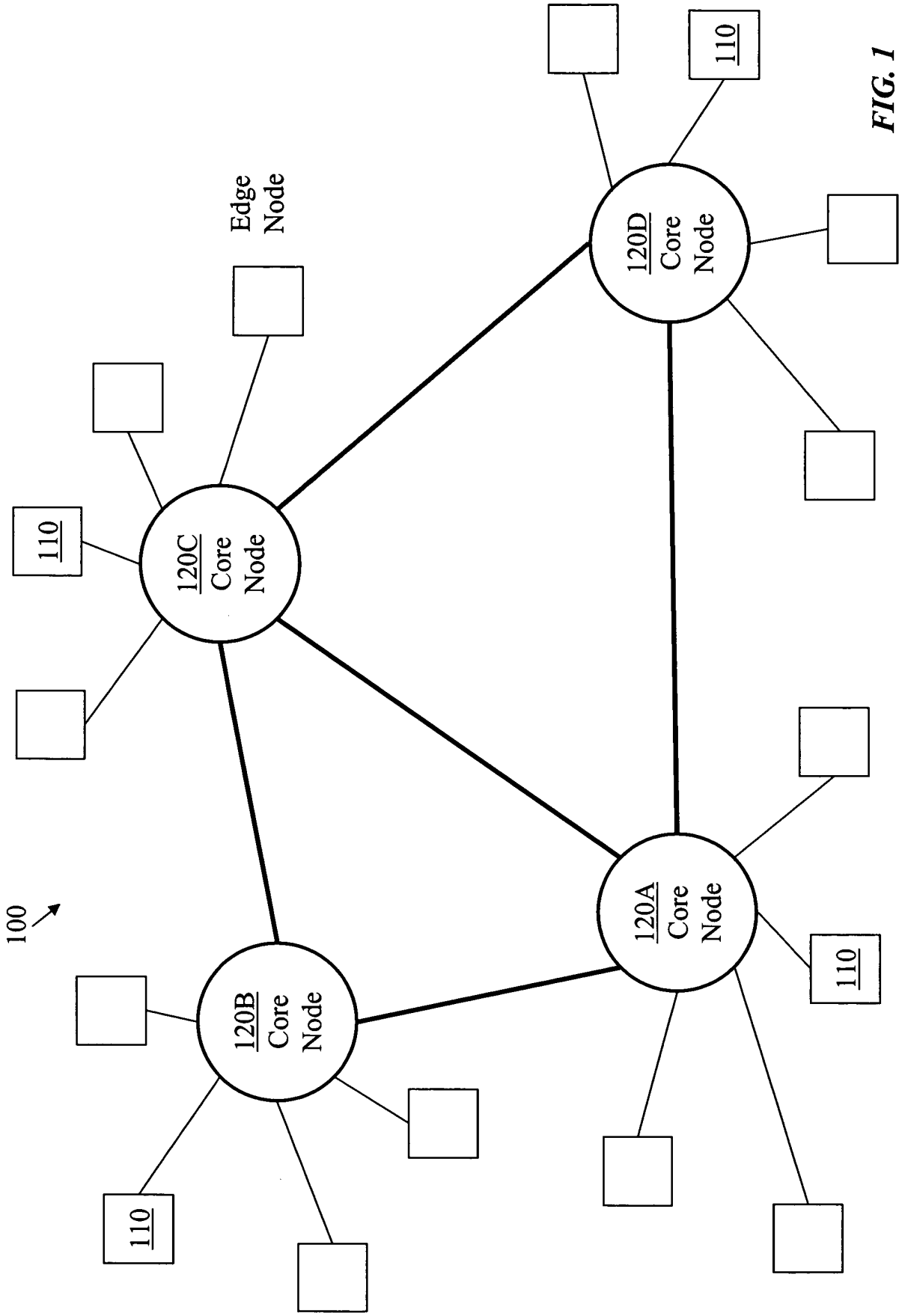

100
120A Core Node
120B Core Node
120C Core Node
120D Core Node
Edge Node
110
110
110
110

FIG. 1

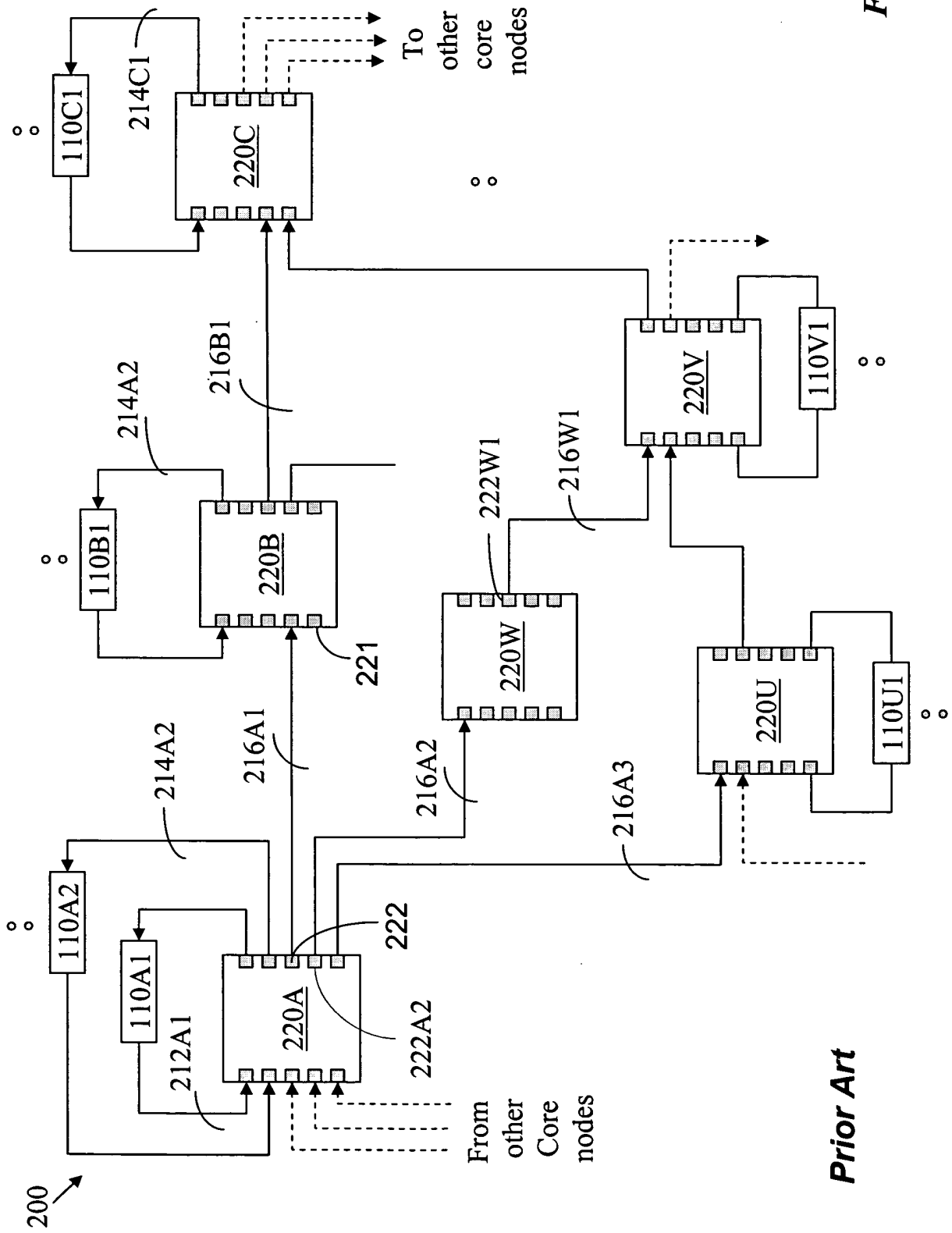


FIG. 2

Prior Art

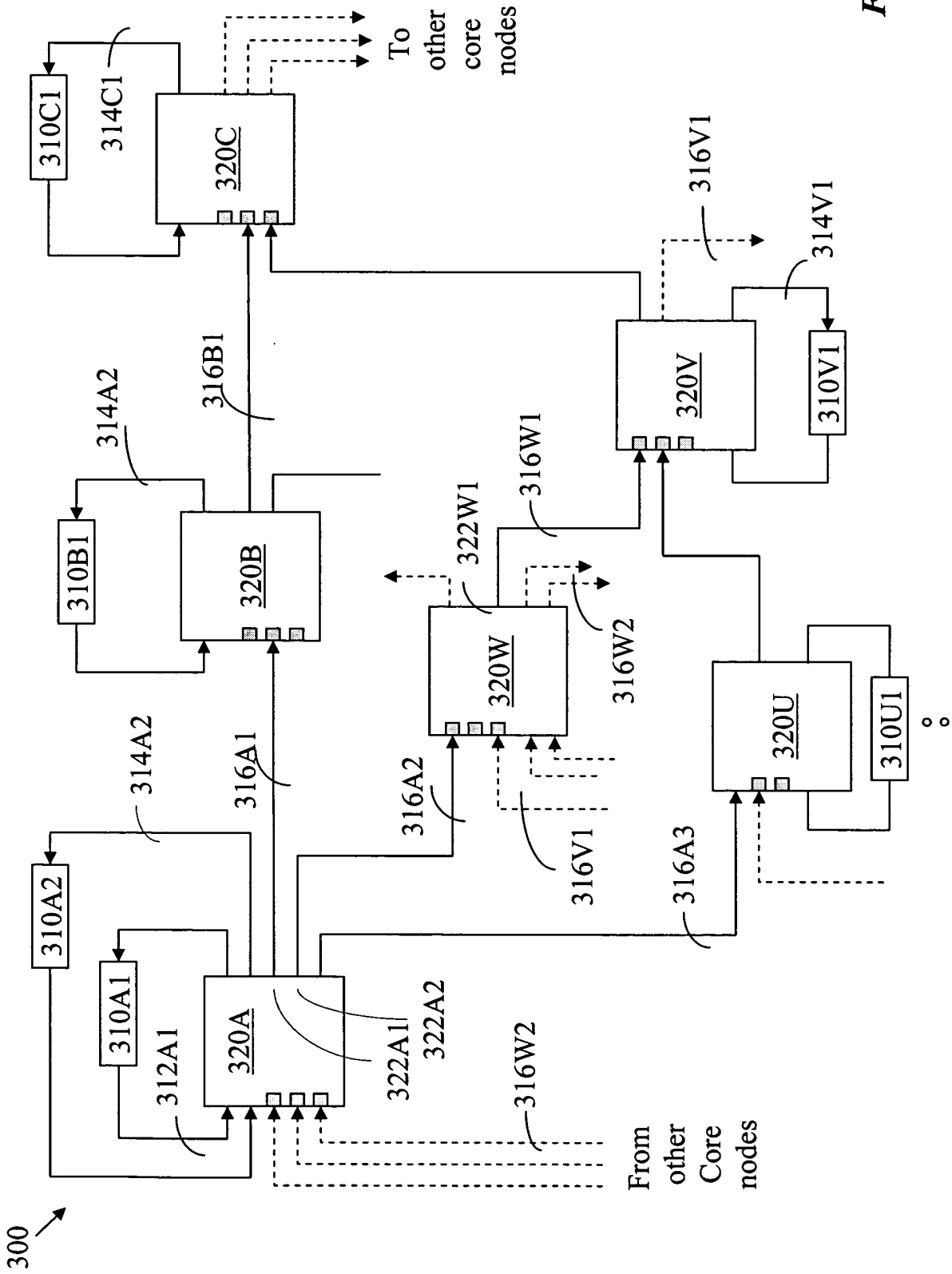

300
310A1
310A2
312A1
320A
322A1
322A2
316W2
From other Core nodes
316A1
314A2
316A2
316V1
316A3
320W
322W1
316W1
316W2
320U
310U1
310B1
314A2
316B1
320B
320V
316V1
314V1
310V1
310C1
314C1
320C
To other core nodes

FIG. 3

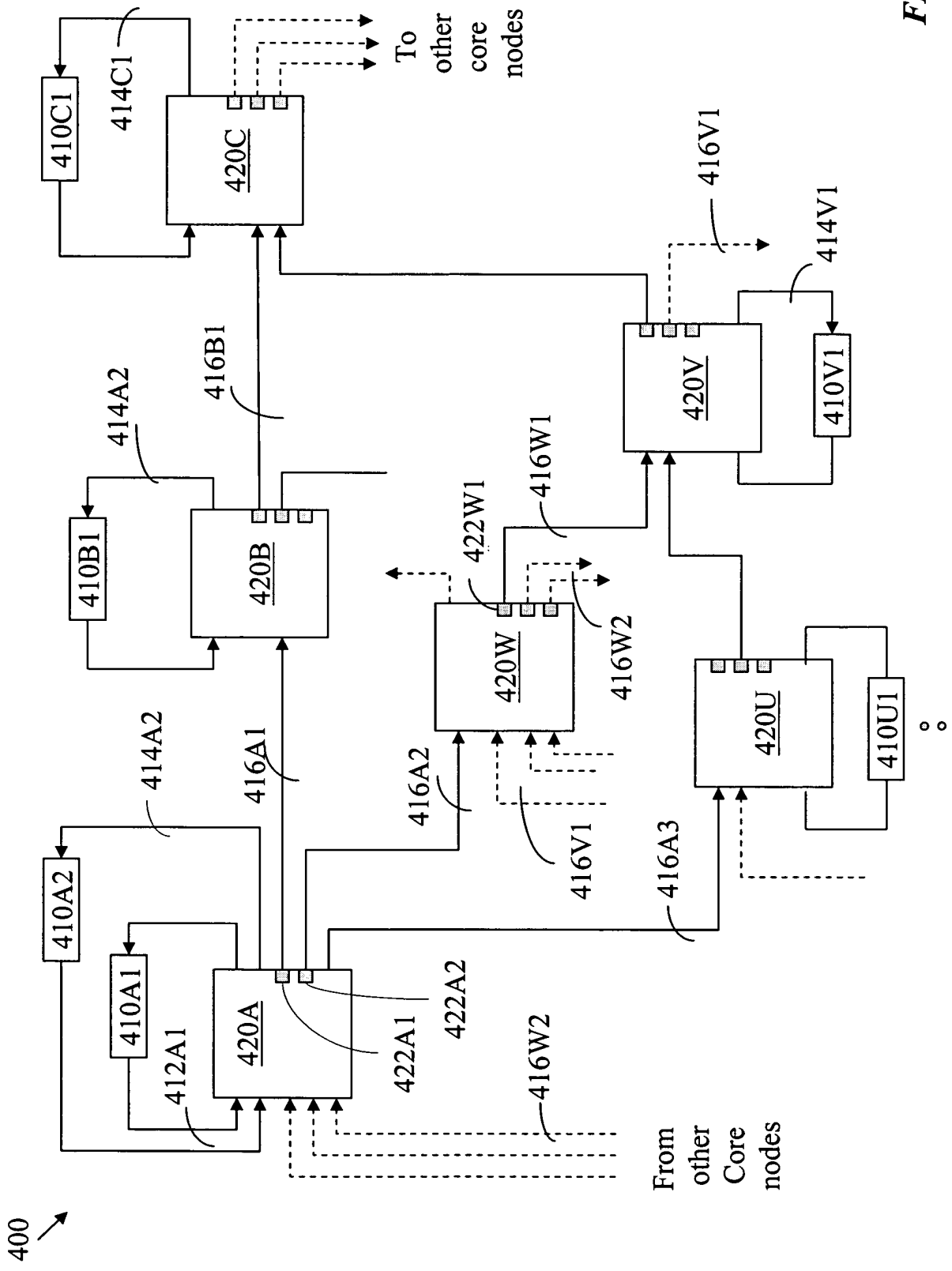

400
410A2
410A1
412A1
420A
414A2
410B1
420B
414A2
410C1
414C1
420C
To other core nodes
416B1
416A1
422A2
422A1
416W2
From other Core nodes
416A2
420W
422W1
416W1
416W2
416V1
416A3
420V
416V1
414V1
410V1
420U
410U1

FIG. 4

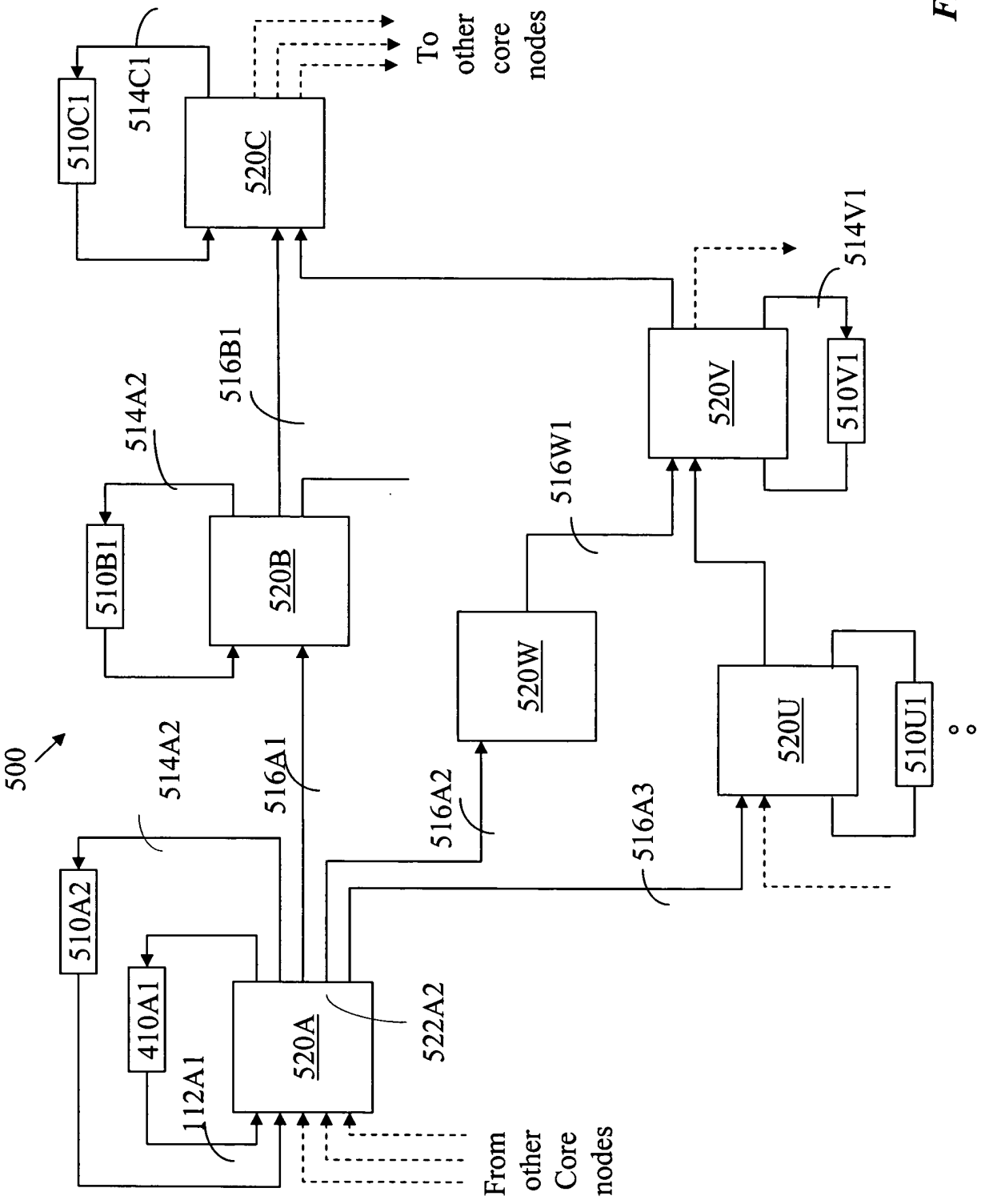

500
510C1
514C1
520C
To other core nodes
514V1
510V1
520V
516W1
516B1
514A2
510B1
520B
520W
520U
510U1
514A2
516A1
516A2
516A3
510A2
410A1
112A1
520A
522A2
From other Core nodes

FIG. 5

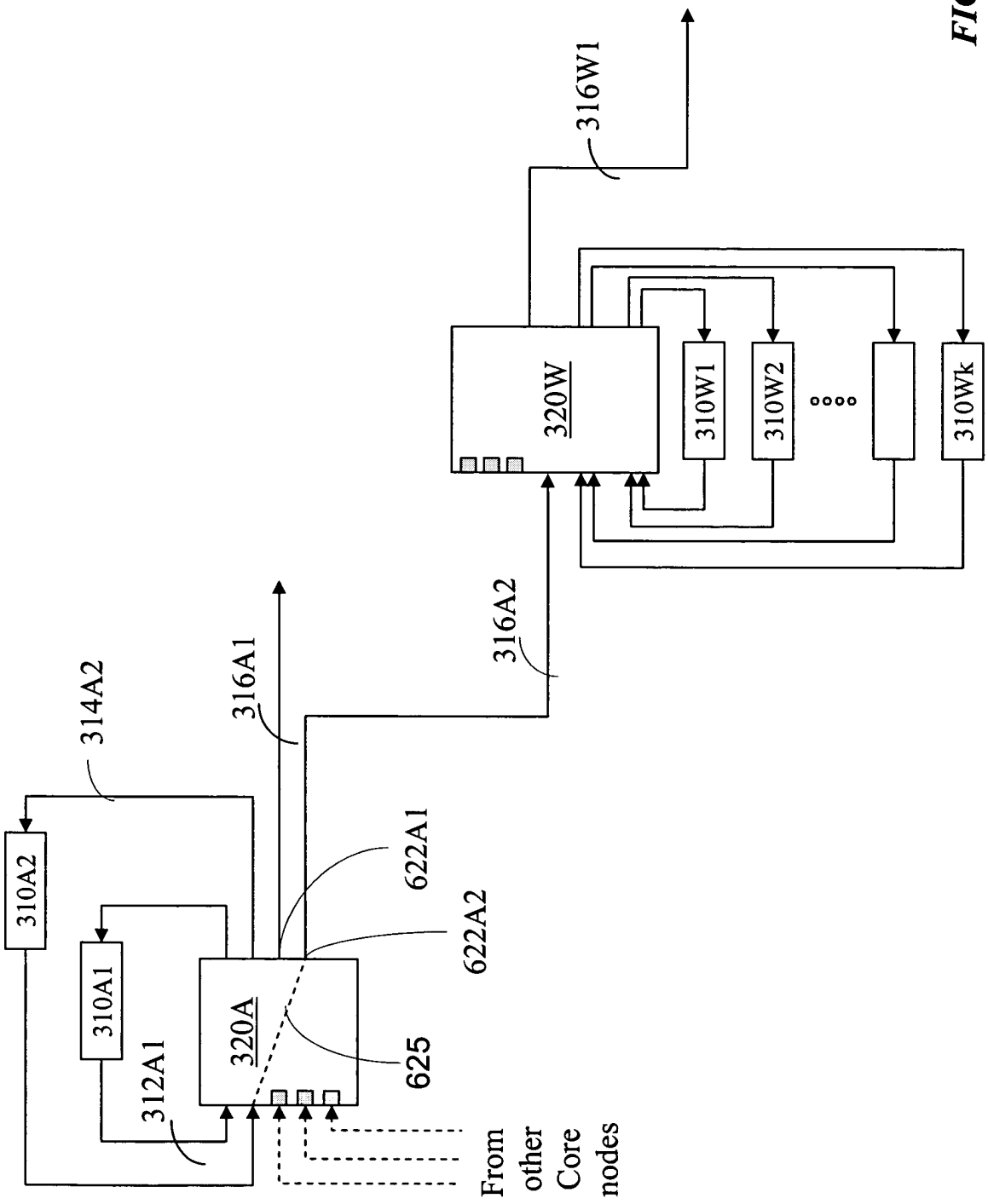

316W1
320W
310W1
310W2
310Wk
316A2
316A1
314A2
622A1
622A2
310A2
310A1
320A
625
312A1
From other Core nodes

FIG. 6

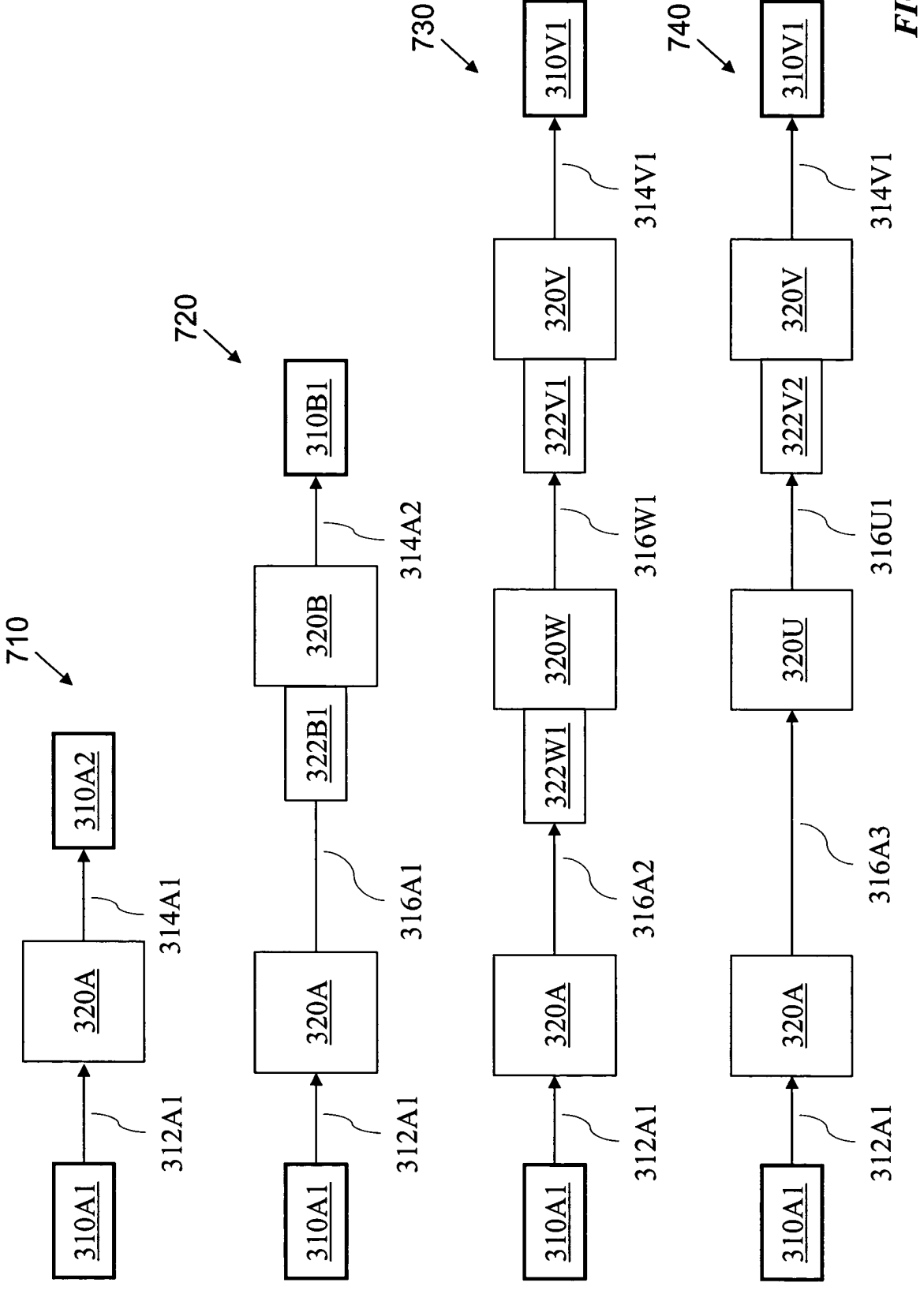

710
310A1
312A1
320A
314A1
310A2
720
310A1
312A1
320A
316A1
322B1
320B
314A2
310B1
730
310A1
312A1
320A
316A2
322W1
320W
316W1
322V1
320V
314V1
310V1
740
310A1
312A1
320A
316A3
320U
316U1
322V2
320V
314V1
310V1

FIG. 7

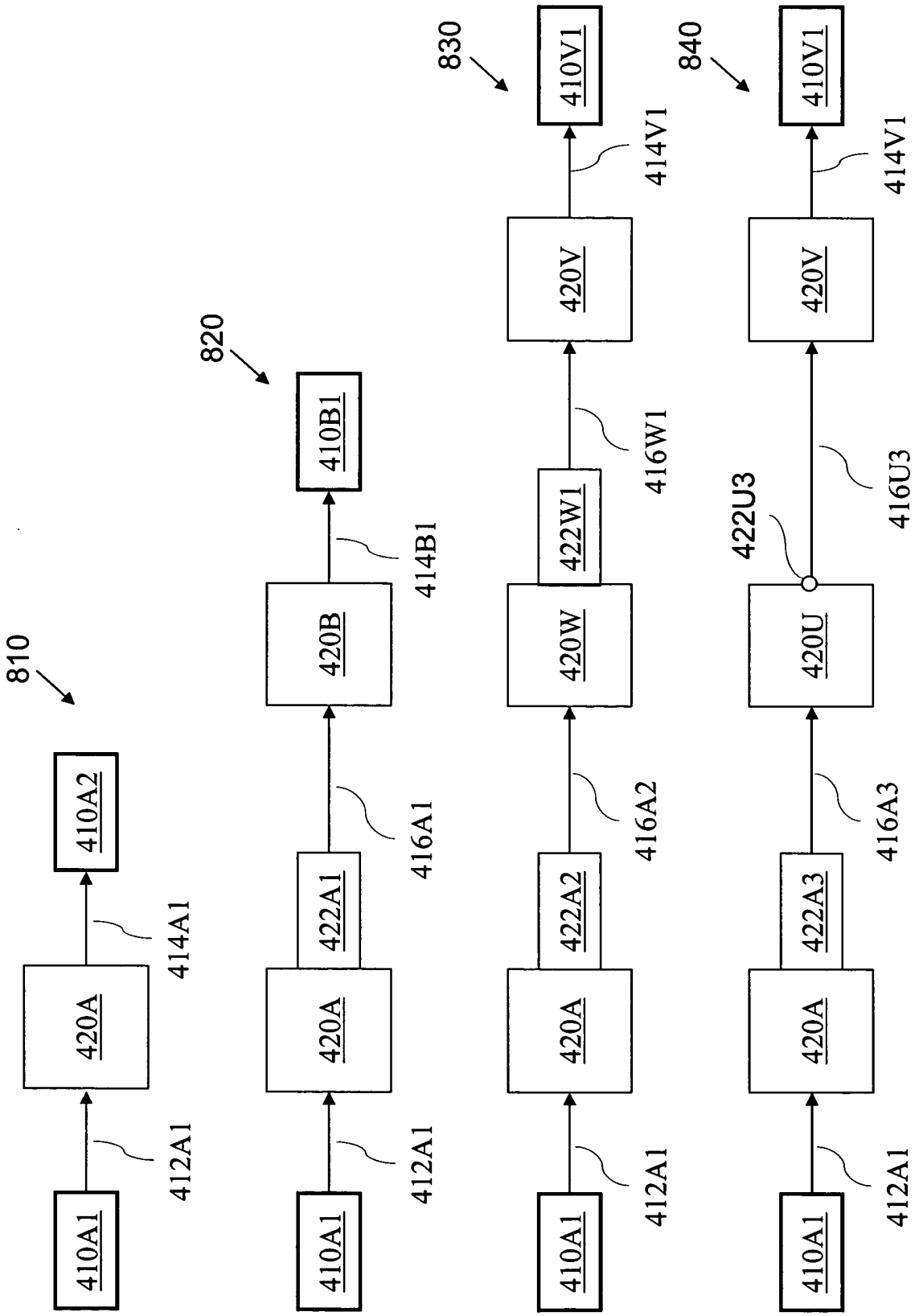

810
410A1
412A1
420A
414A1
410A2
820
410A1
412A1
420A
422A1
416A1
420B
414B1
410B1
830
410A1
412A1
420A
422A2
416A2
420W
422W1
416W1
420V
414V1
410V1
840
410A1
412A1
420A
422A3
416A3
420U
422U3
416U3
420V
414V1
410V1

FIG. 8

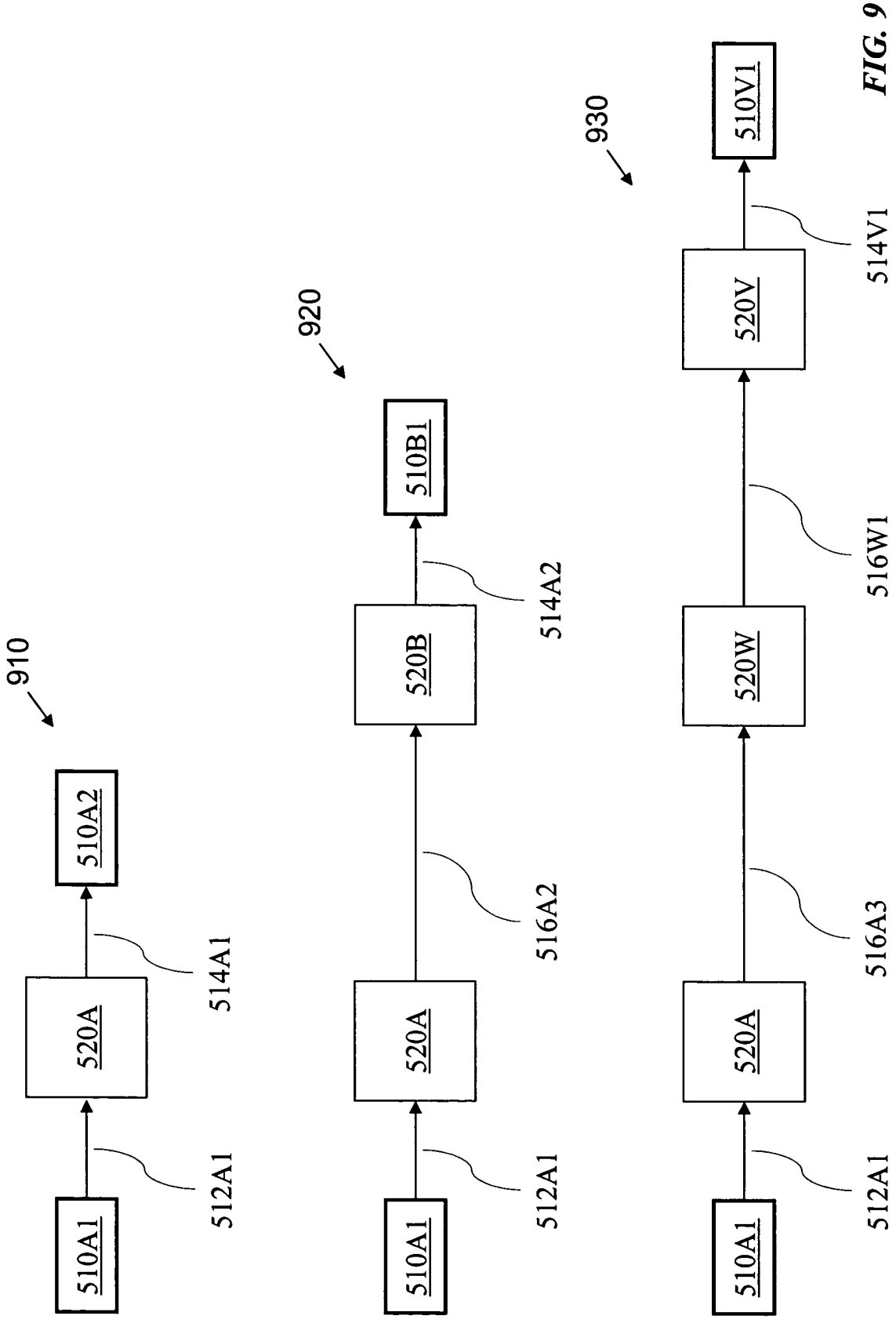
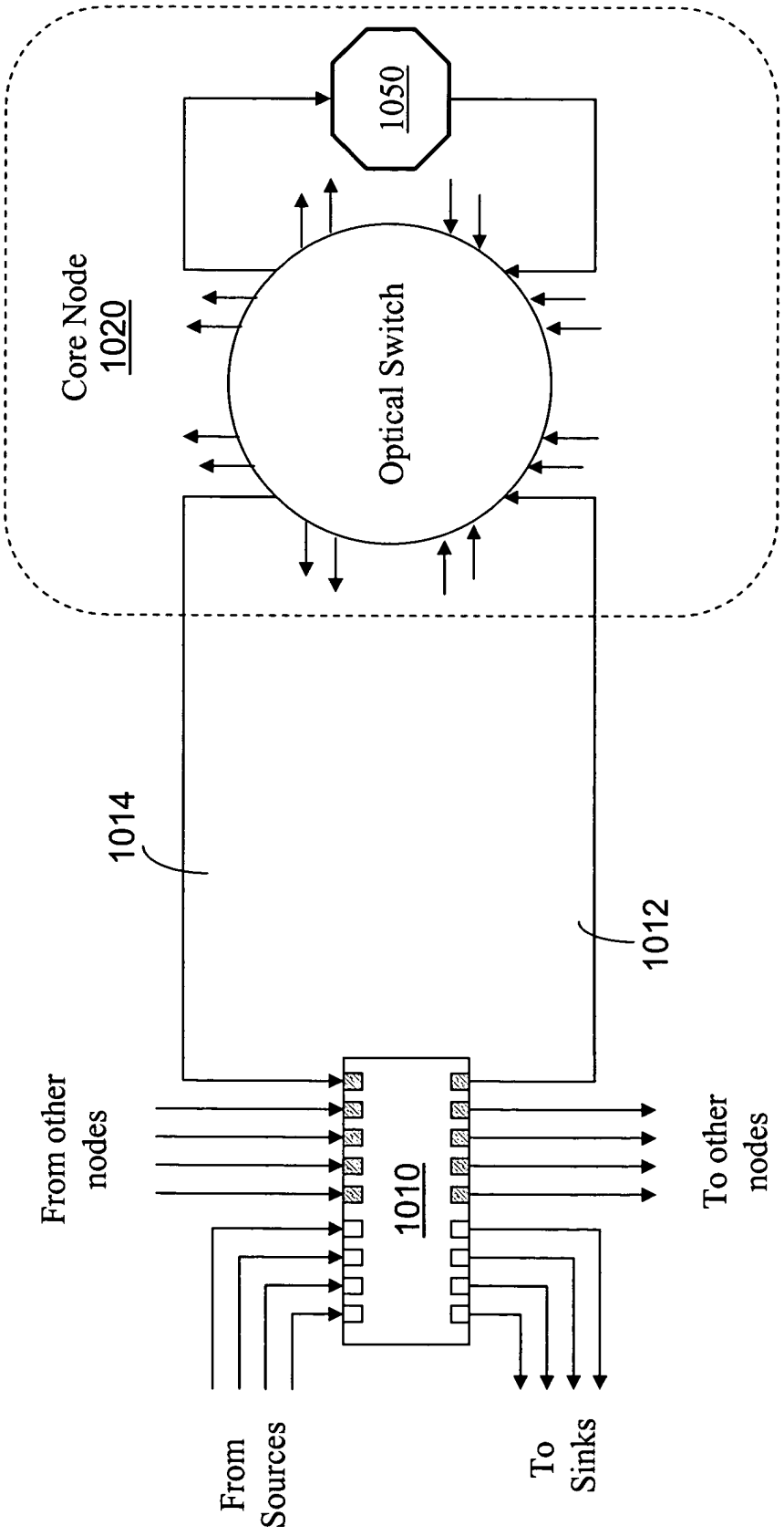

910
510A1
512A1
520A
514A1
510A2
920
510A1
512A1
520A
516A2
520B
514A2
510B1
930
510A1
512A1
520A
516A3
520W
516W1
520V
514V1
510V1

FIG. 9



Prior Art

FIG. 10

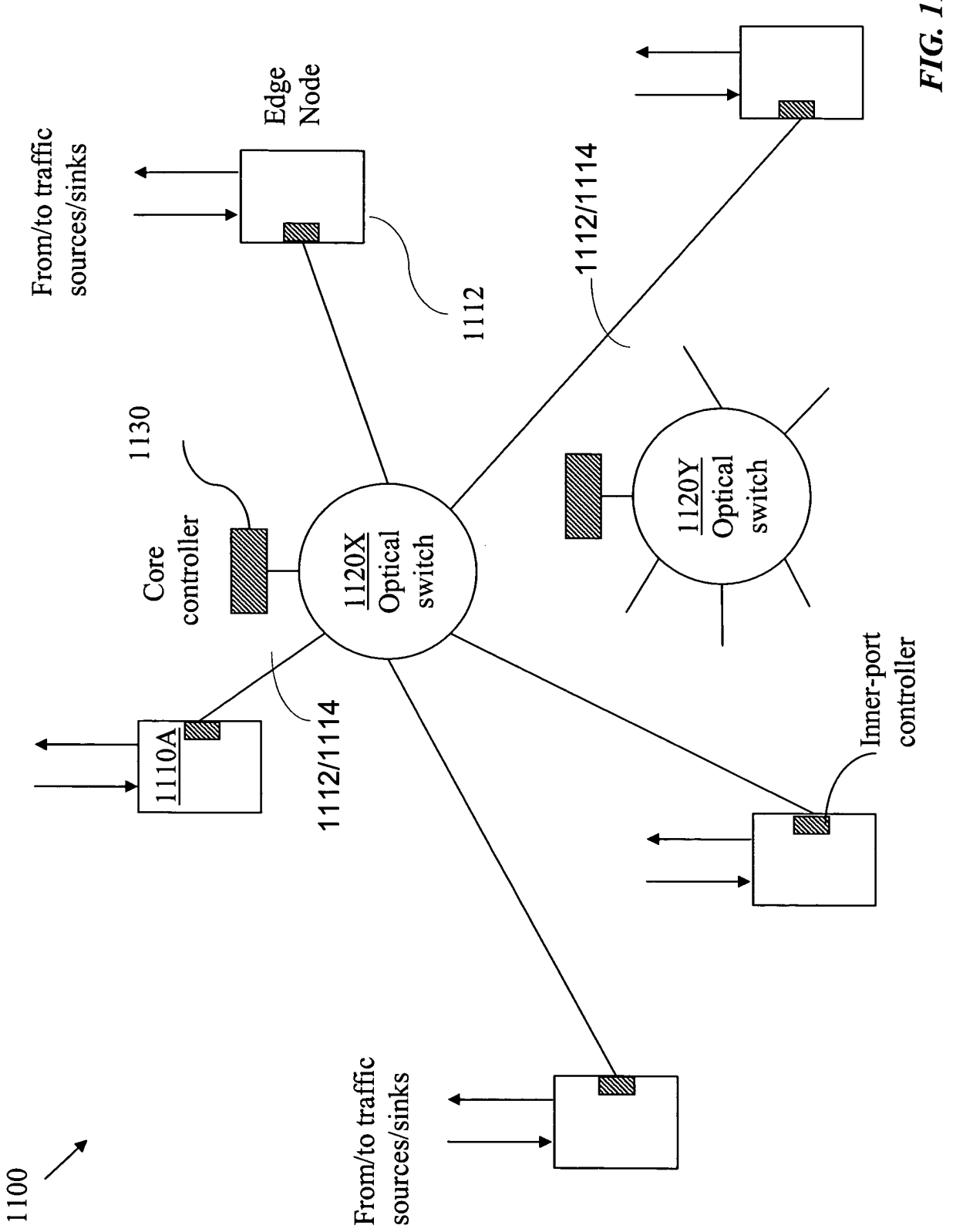

1100
From/to traffic sources/sinks
Edge Node
1112
1112/1114
1130
Core controller
1120X Optical switch
1120Y Optical switch
1110A
1112/1114
Inner-port controller
From/to traffic sources/sinks

FIG. 11

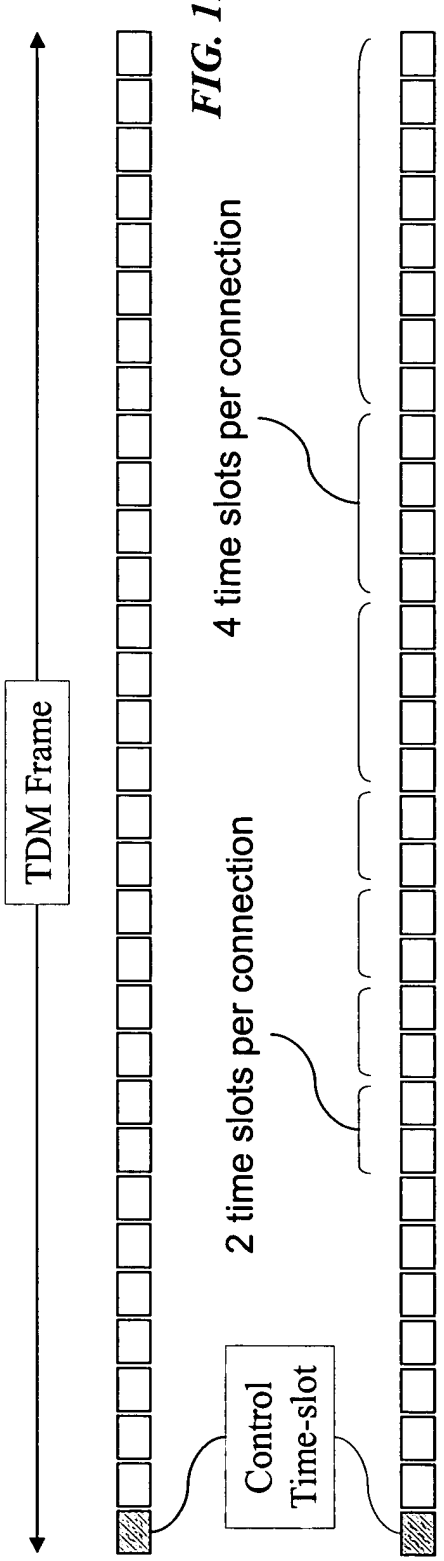


FIG. 12A

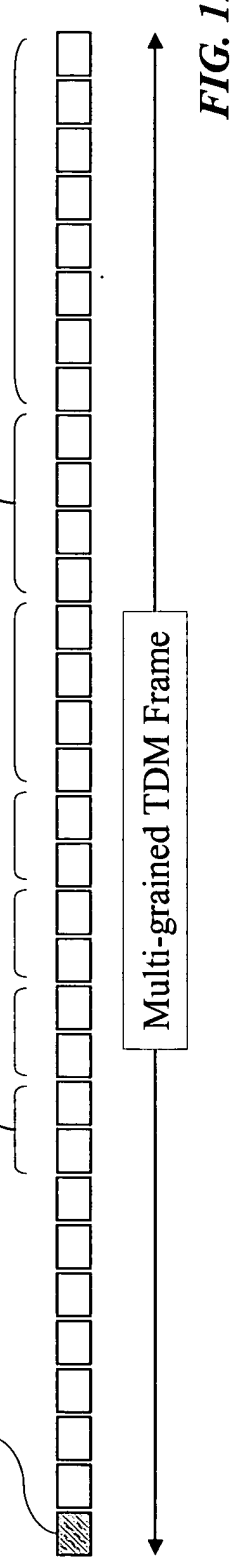


FIG. 12B

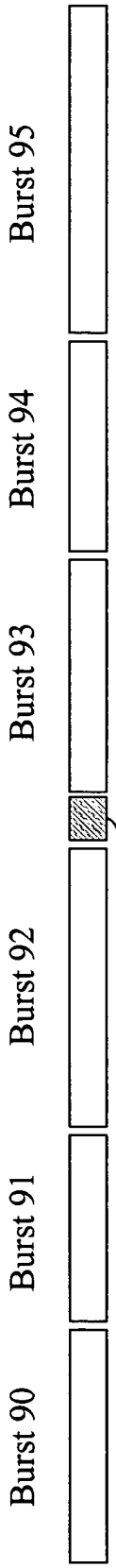


FIG. 12C

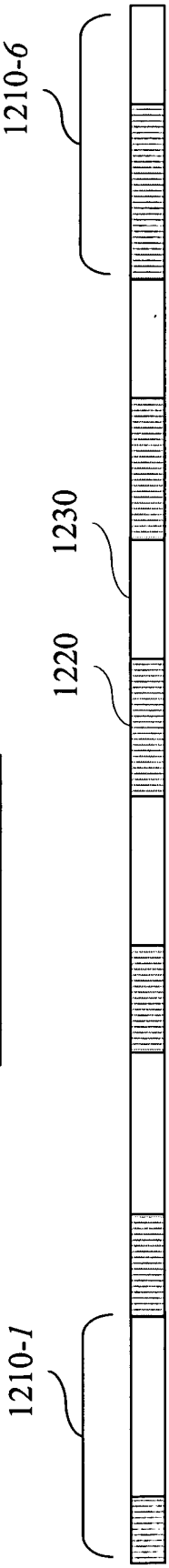


FIG. 12D

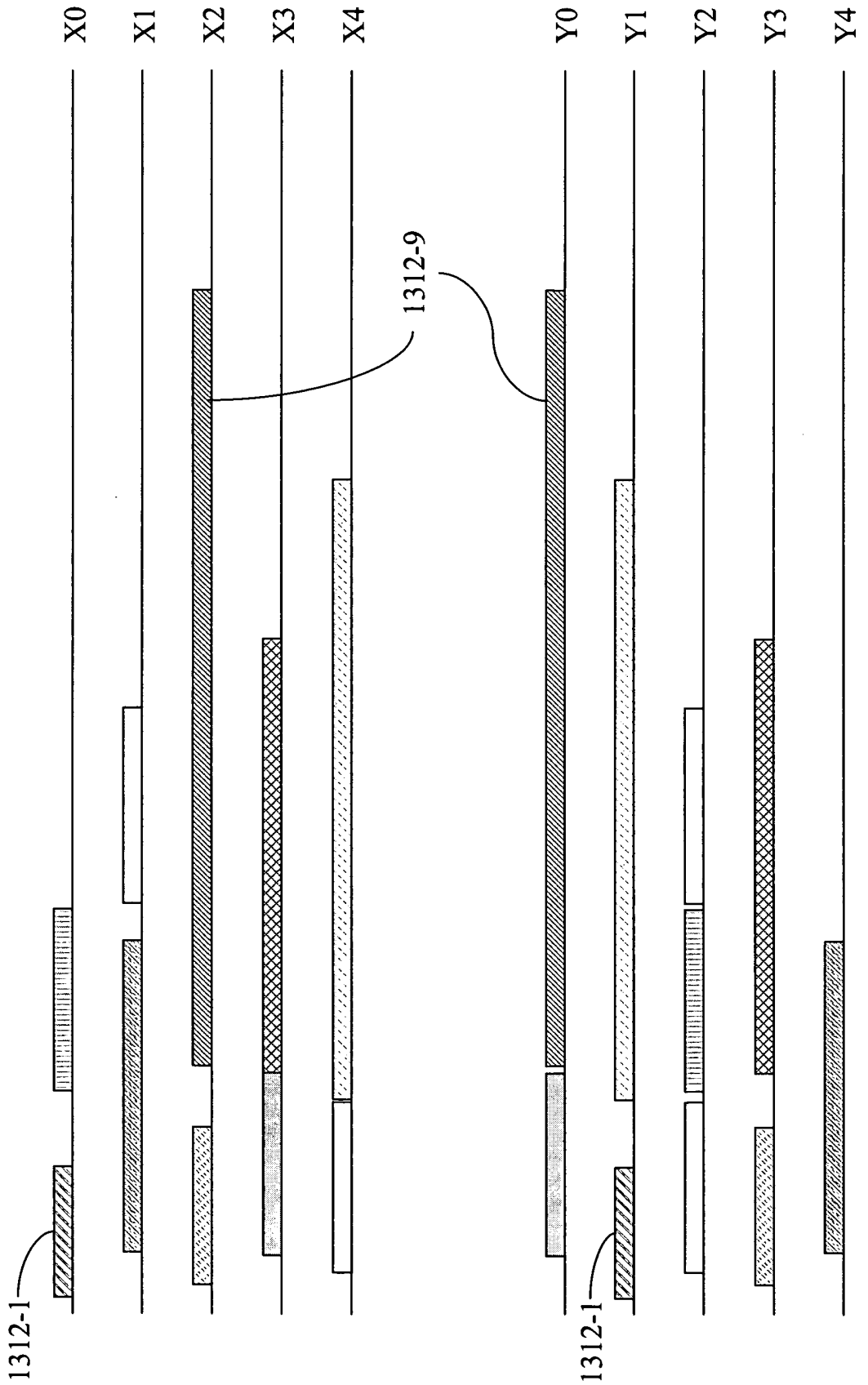


FIG. 13

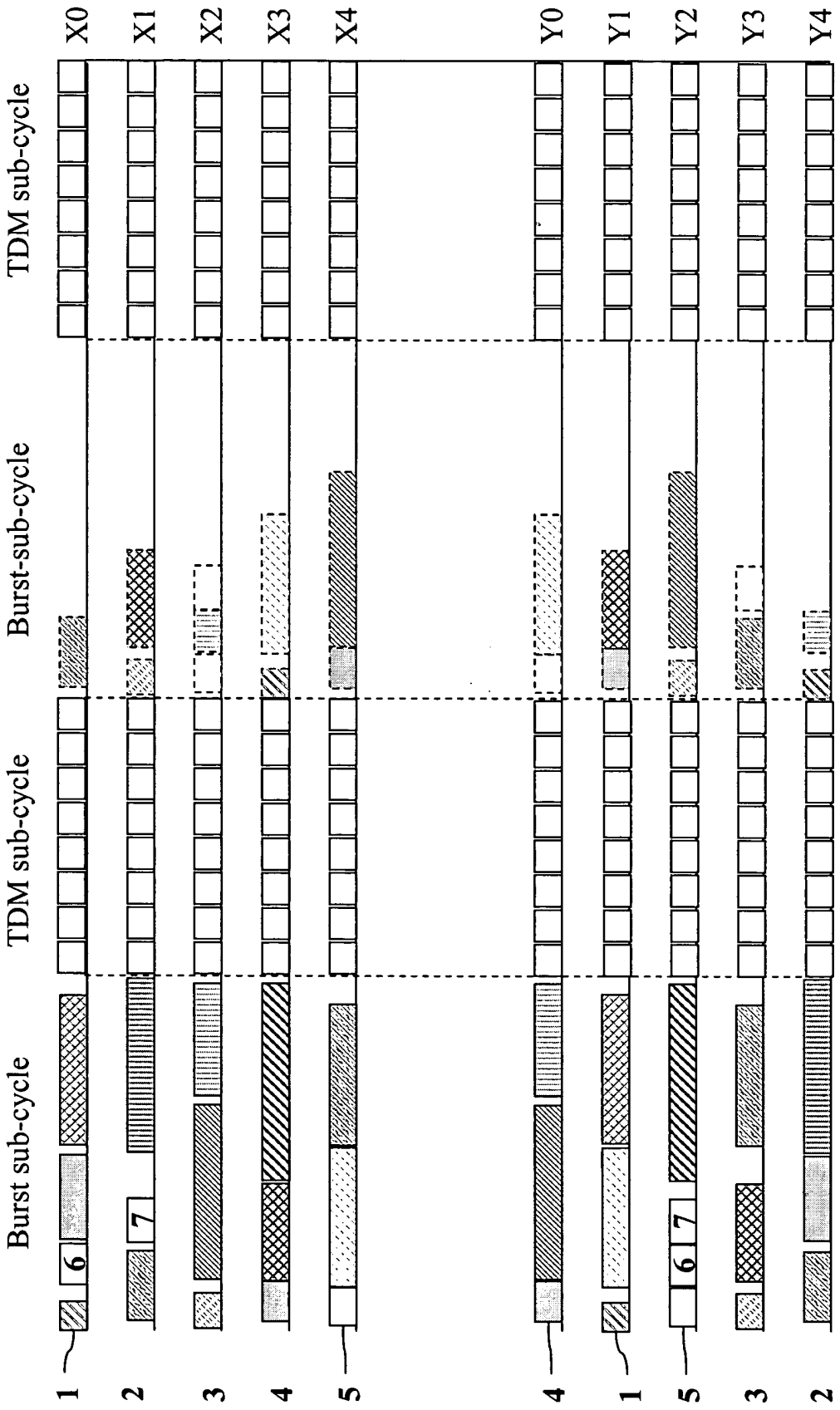

X0
X1
X2
X3
X4
Y0
Y1
Y2
Y3
Y4
TDM sub-cycle
Burst-sub-cycle
TDM sub-cycle
Burst sub-cycle
6
7
1
2
3
4
5
4
1
5
3
2

FIG. 14

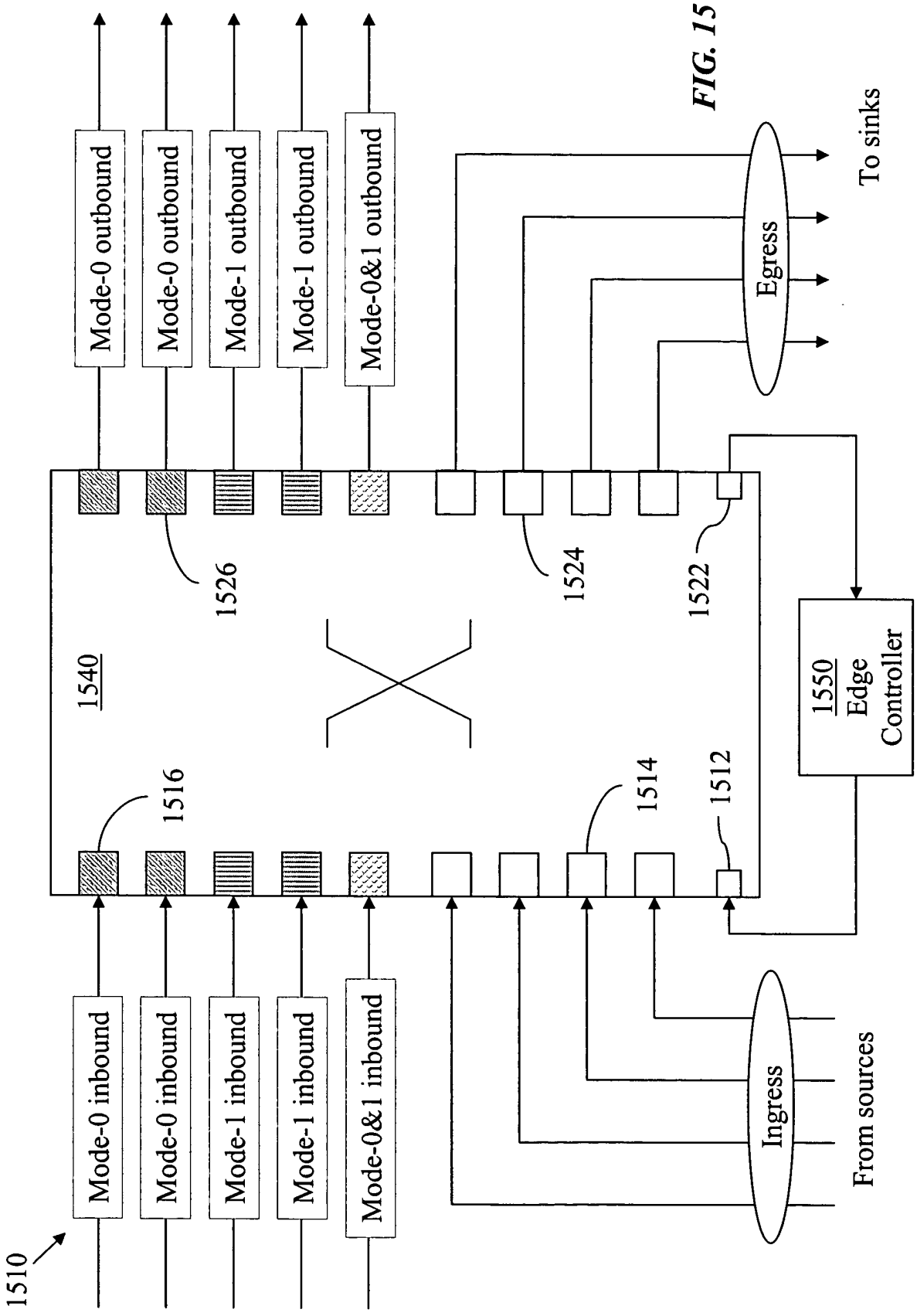

1510
Mode-0 inbound
Mode-0 inbound
Mode-1 inbound
Mode-1 inbound
Mode-0&1 inbound
From sources
Ingress
1512
1514
1516
1540
1550
Edge
Controller
1522
1524
1526
Mode-0 outbound
Mode-0 outbound
Mode-1 outbound
Mode-1 outbound
Mode-0&1 outbound
Egress
To sinks

FIG. 15

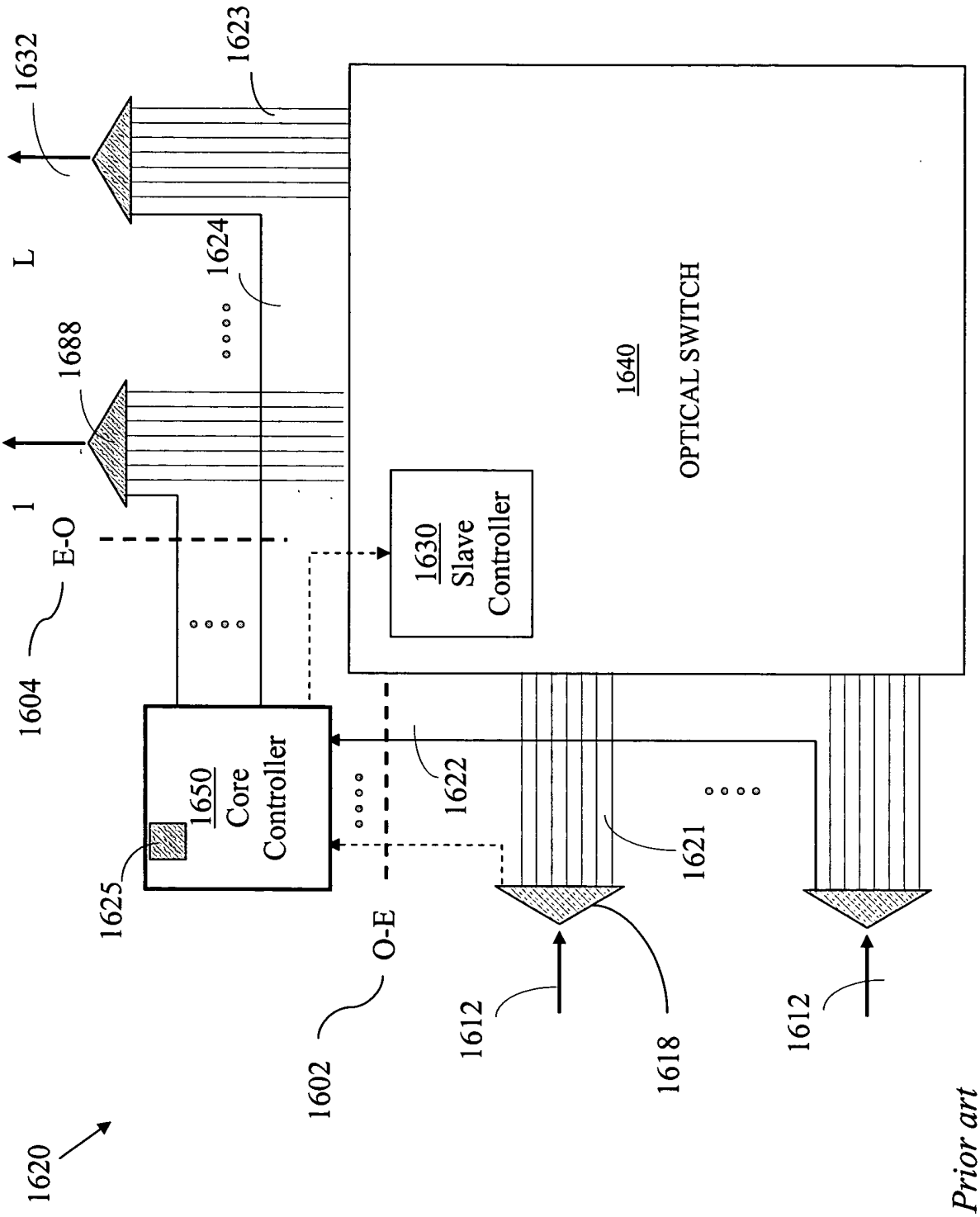


FIG. 16

Prior art

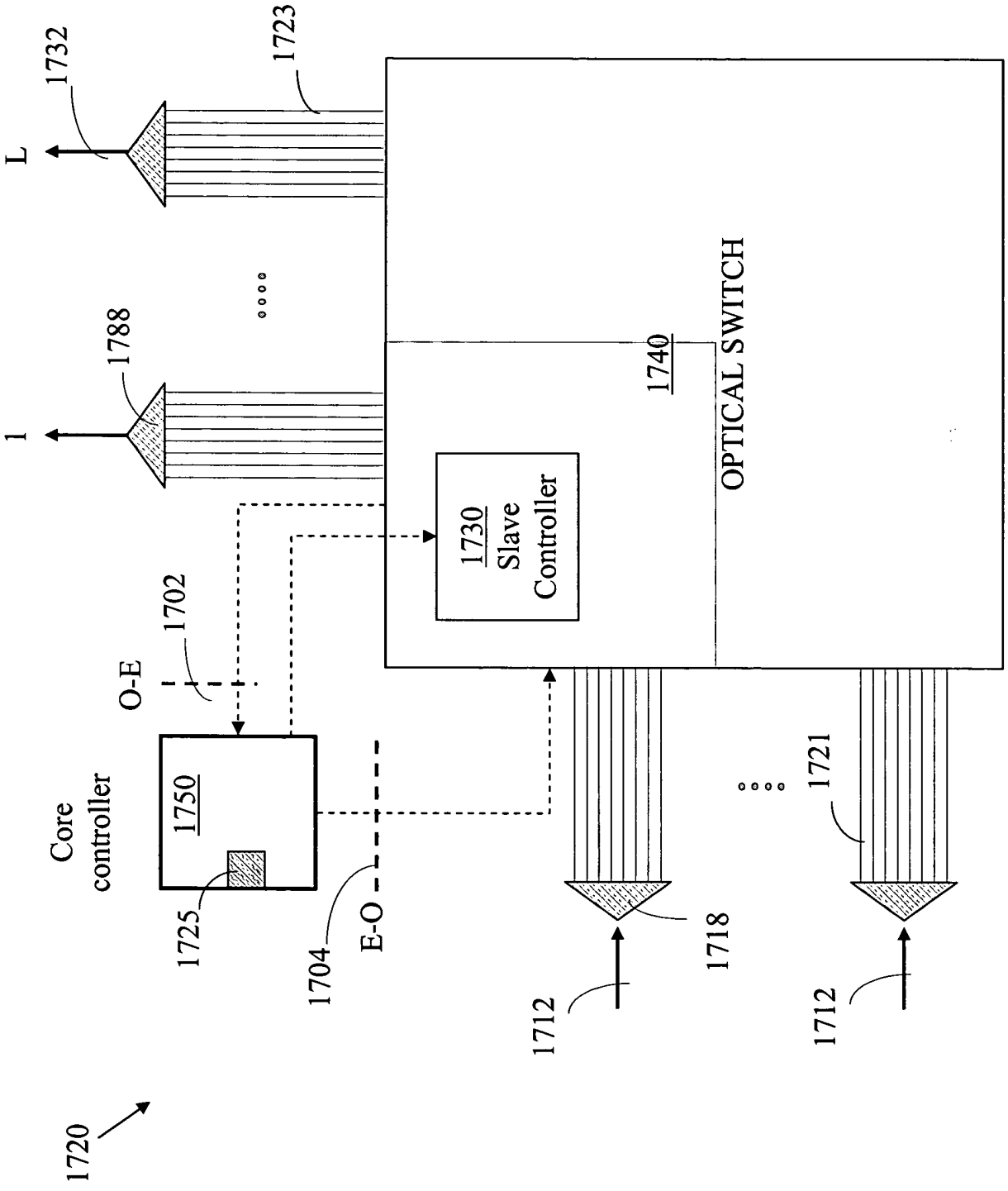

1720
1732
1723
L
1
1788
1740
OPTICAL SWITCH
1730
Slave
Controller
1702
O-E
Core
controller
1750
1725
1704
E-O
1712
1718
1721
1712

FIG. 17

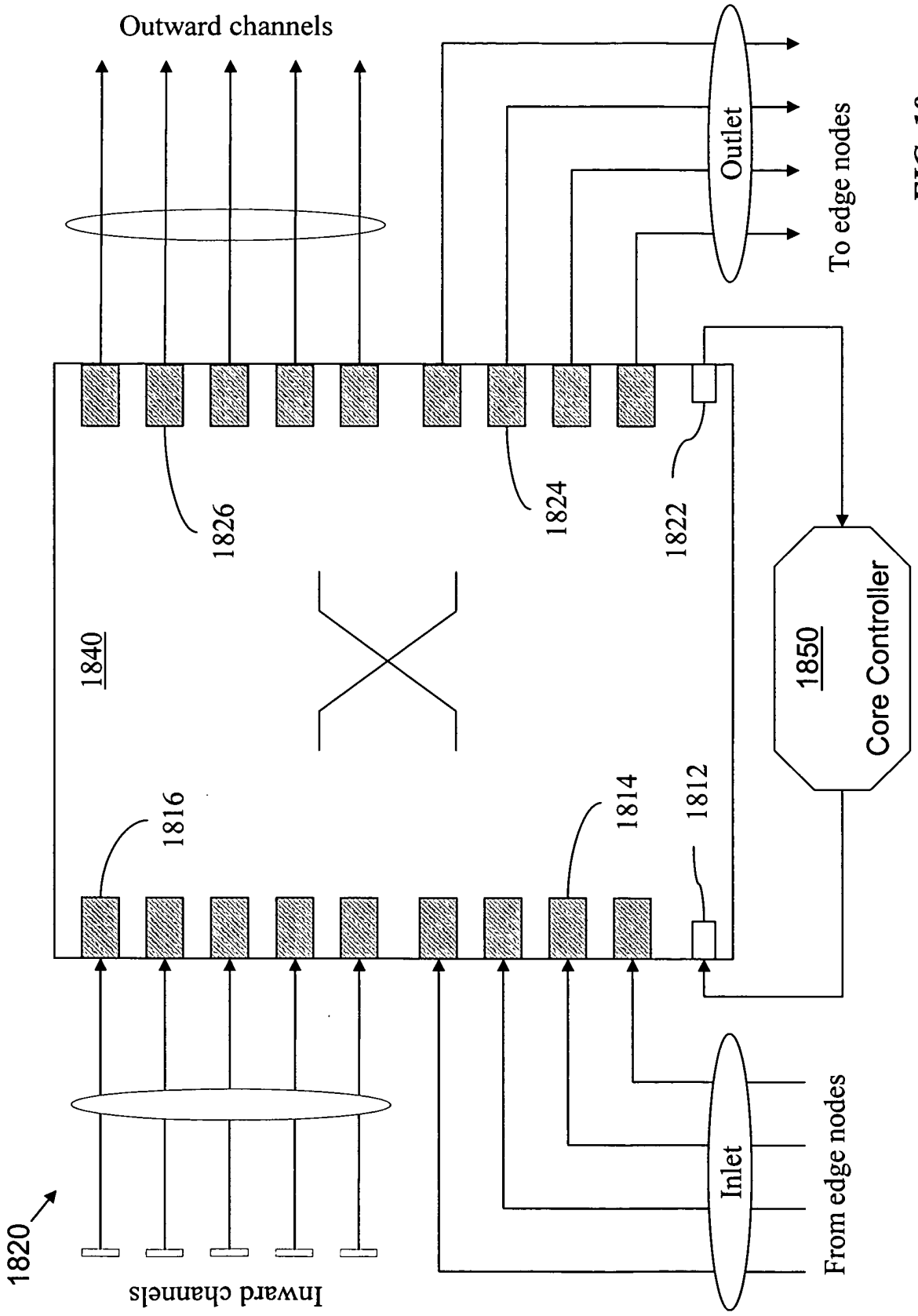

Outward channels
Outlet
To edge nodes
1826
1824
1822
1840
1850
Core Controller
1816
1814
1812
1820
Inward channels
Inlet
From edge nodes

FIG. 18

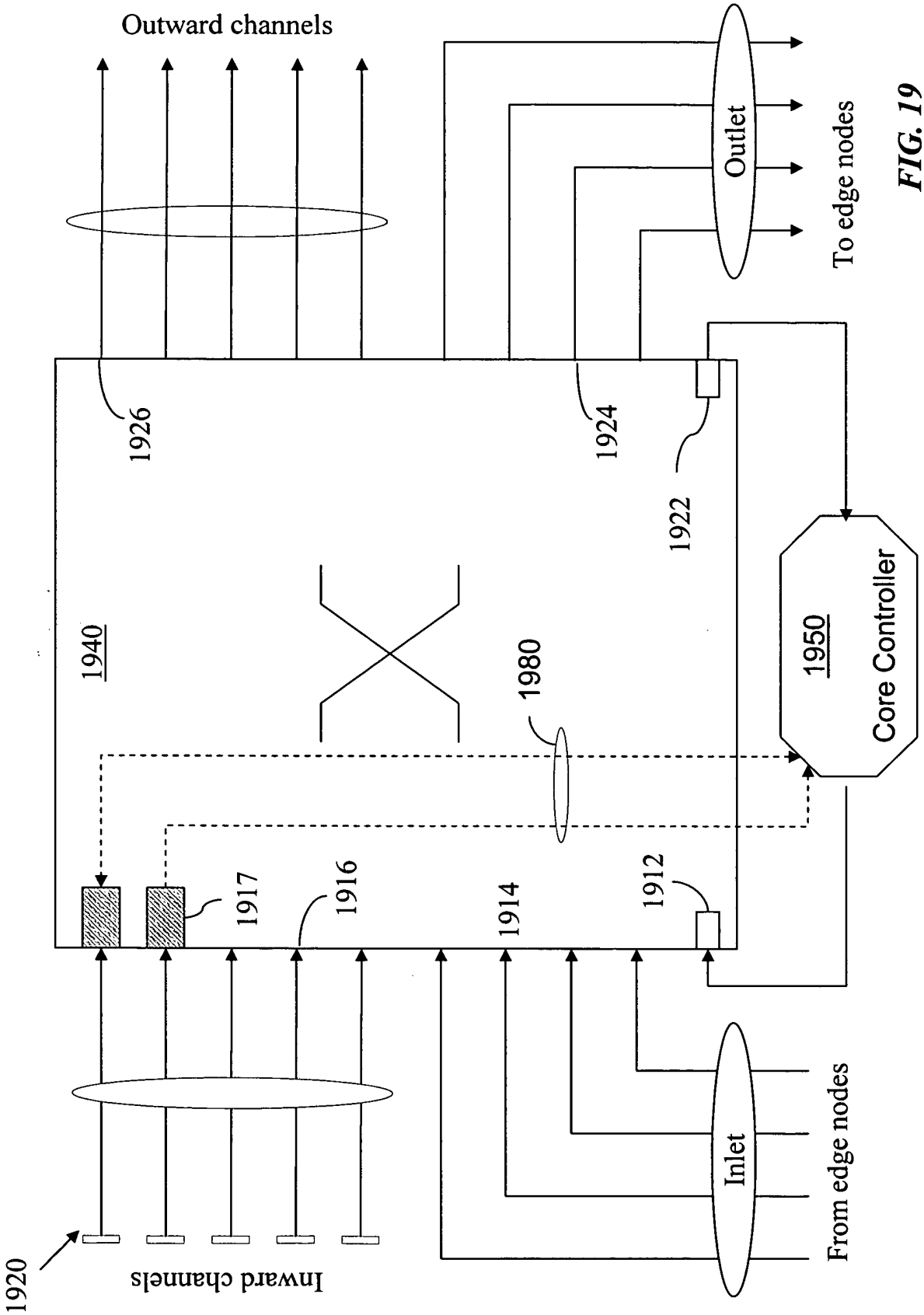

Outward channels
Outlet
To edge nodes
1926
1924
1922
1940
1980
1950
Core Controller
1917
1916
1914
1912
Inlet
From edge nodes
1920
Inward channels

FIG. 19

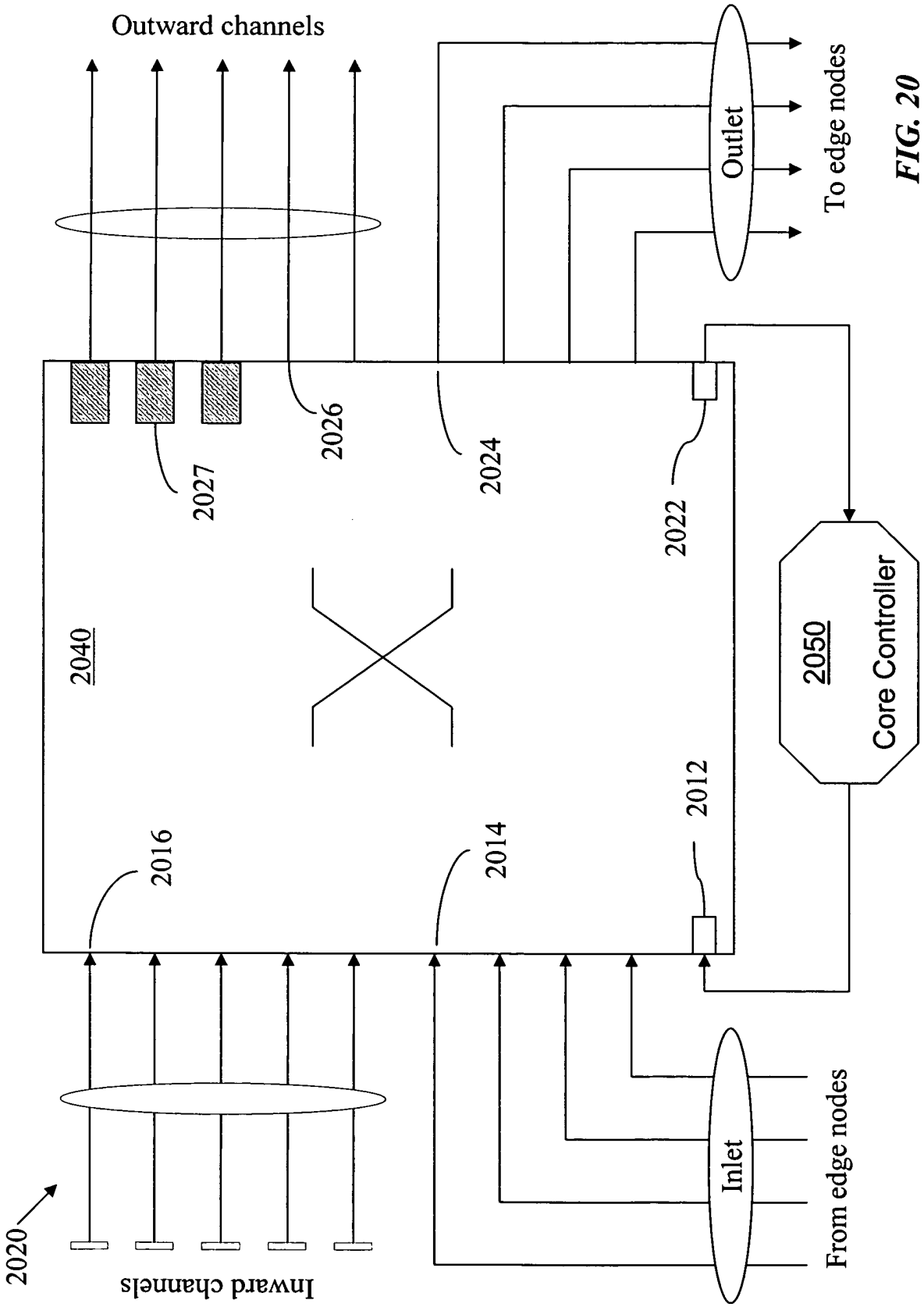

Outward channels
Outlet
To edge nodes
2026
2024
2027
2022
2040
2050
Core Controller
2012
2016
2014
2020
Inward channels
Inlet
From edge nodes

FIG. 20

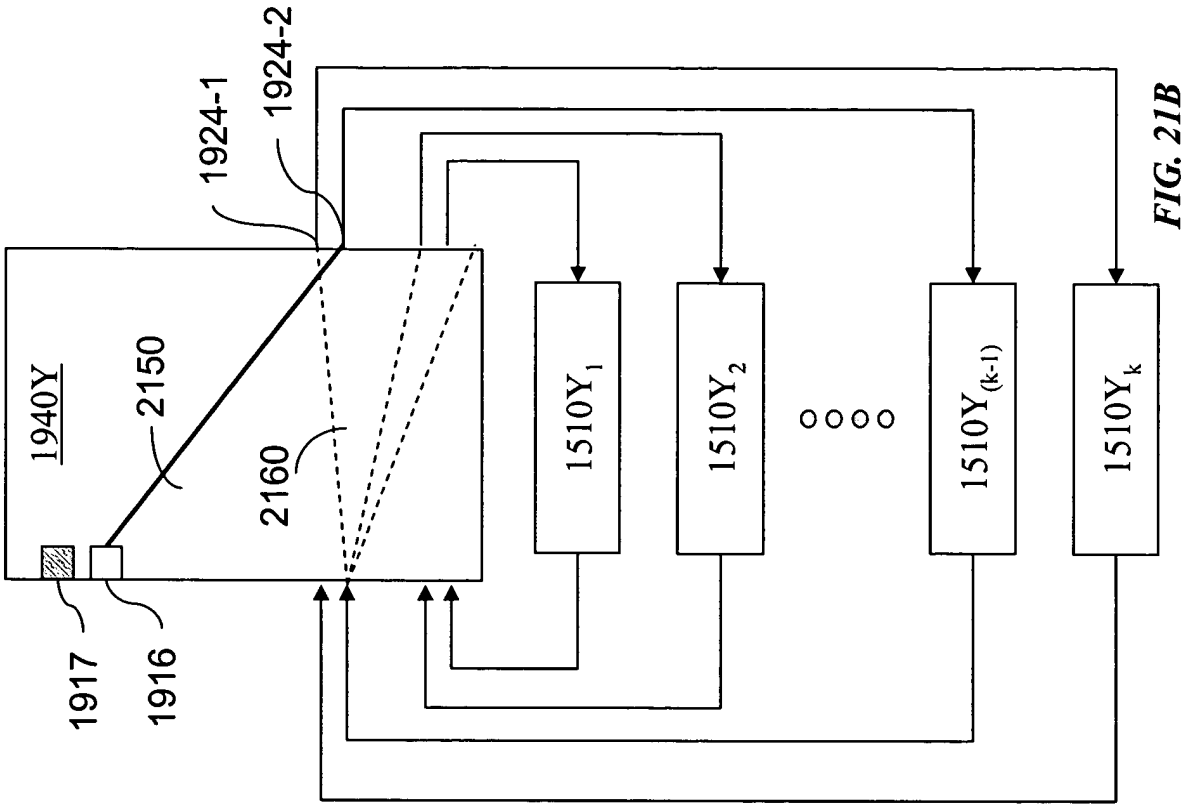


FIG. 21B

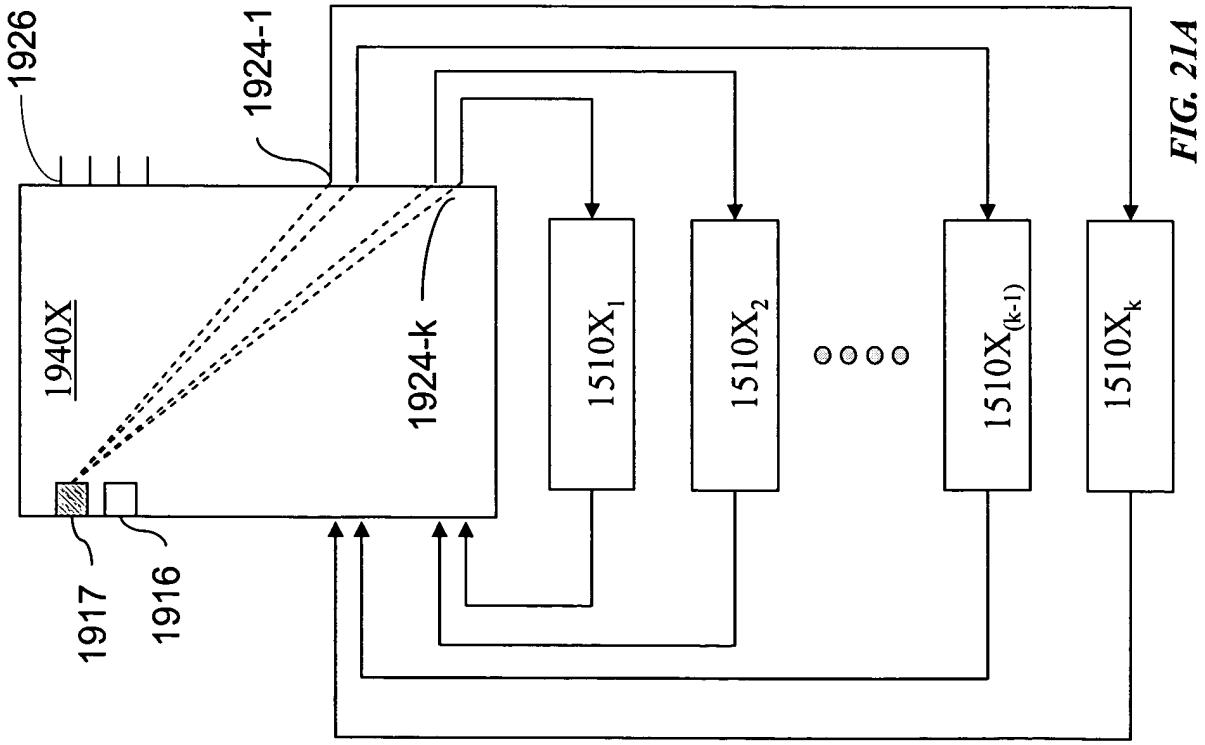


FIG. 21A

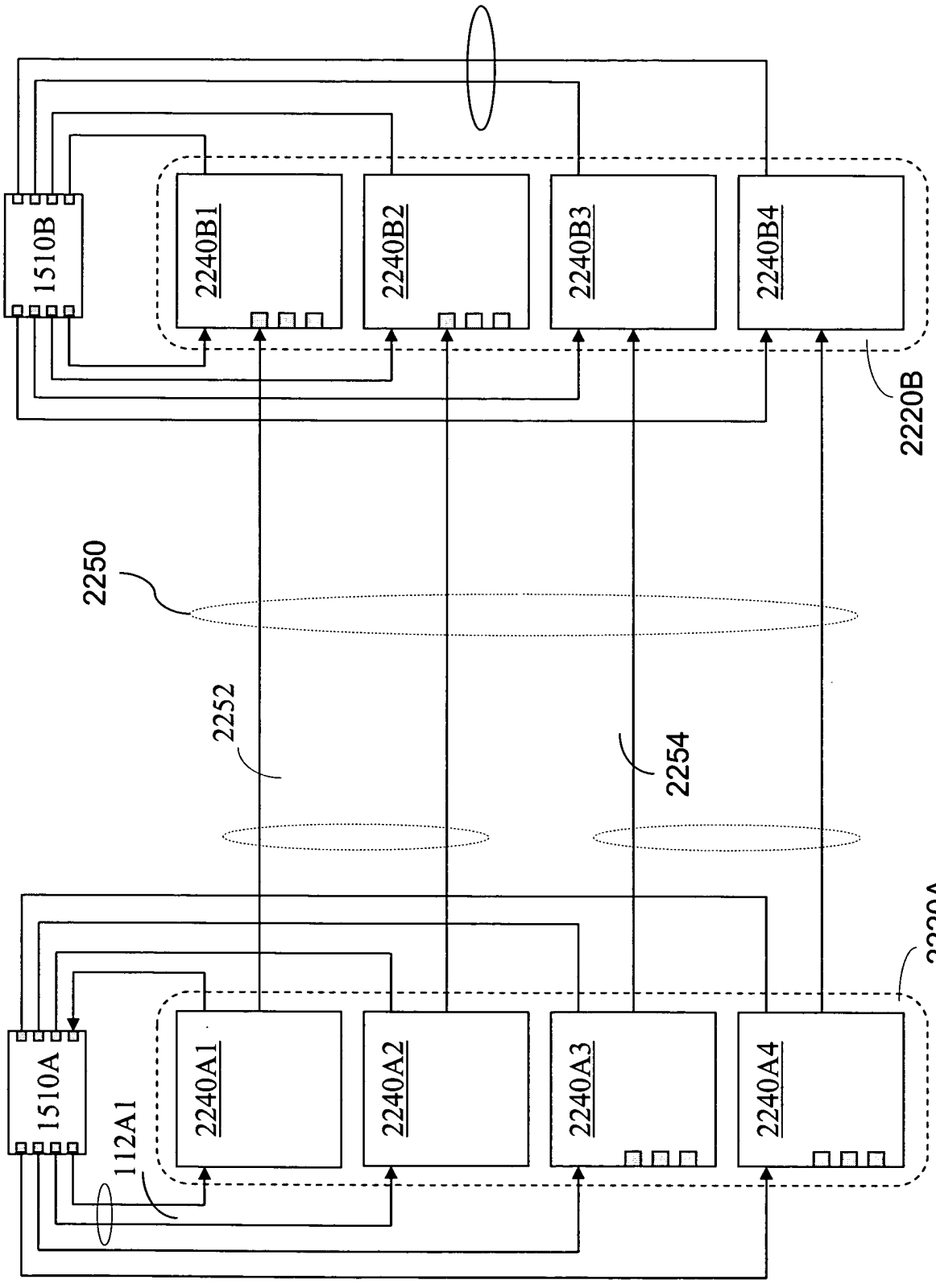

1510B
2240B1
2240B2
2240B3
2240B4
2220B
2250
2252
2254
2220A
1510A
112A1
2240A1
2240A2
2240A3
2240A4

FIG. 22

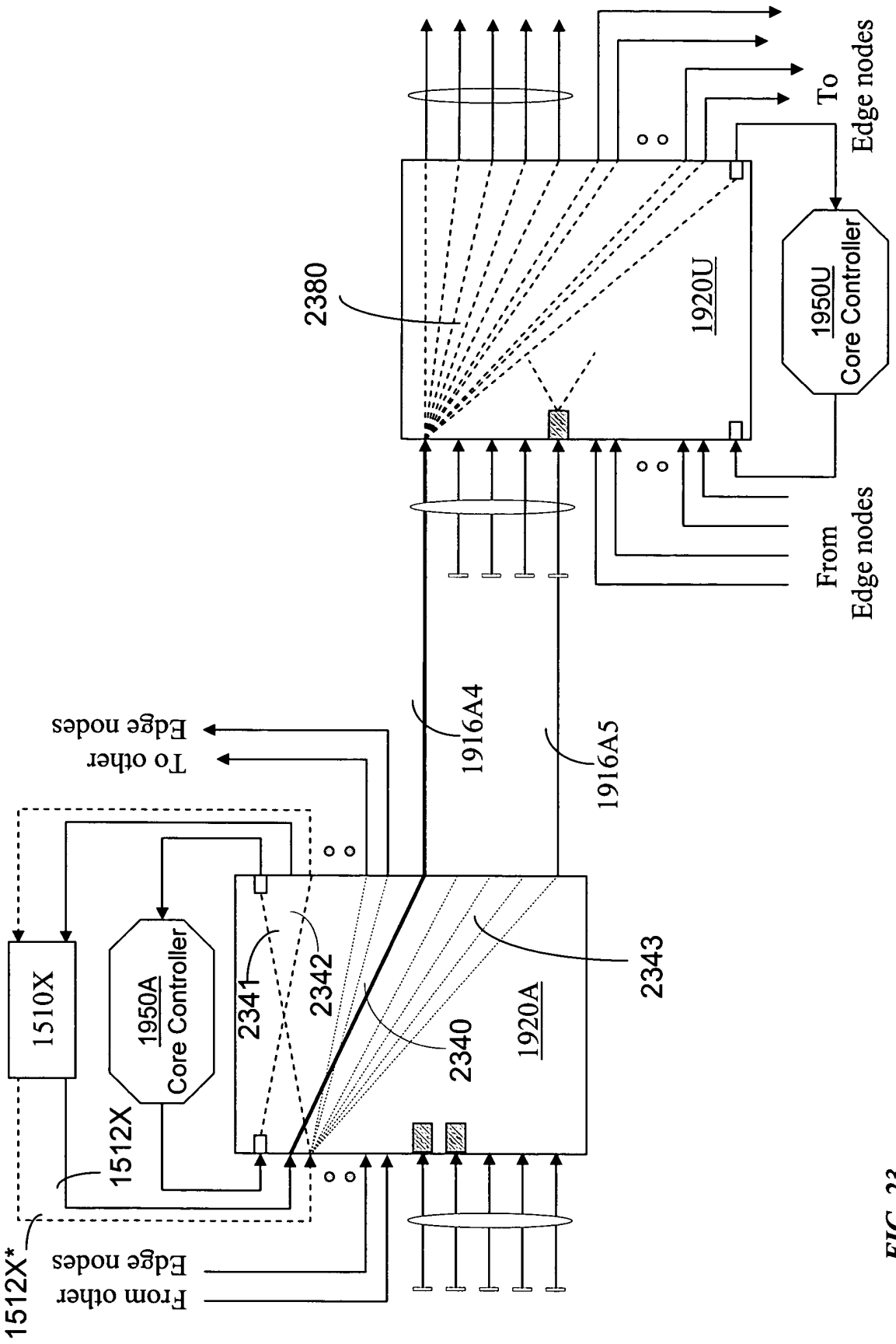

To Edge nodes
2380
1920U
1950U Core Controller
From Edge nodes
1916A4
1916A5
To other Edge nodes
1510X
1950A Core Controller
2341
2342
2343
2340
1920A
1512X
1512X*
From other Edge nodes

FIG. 23

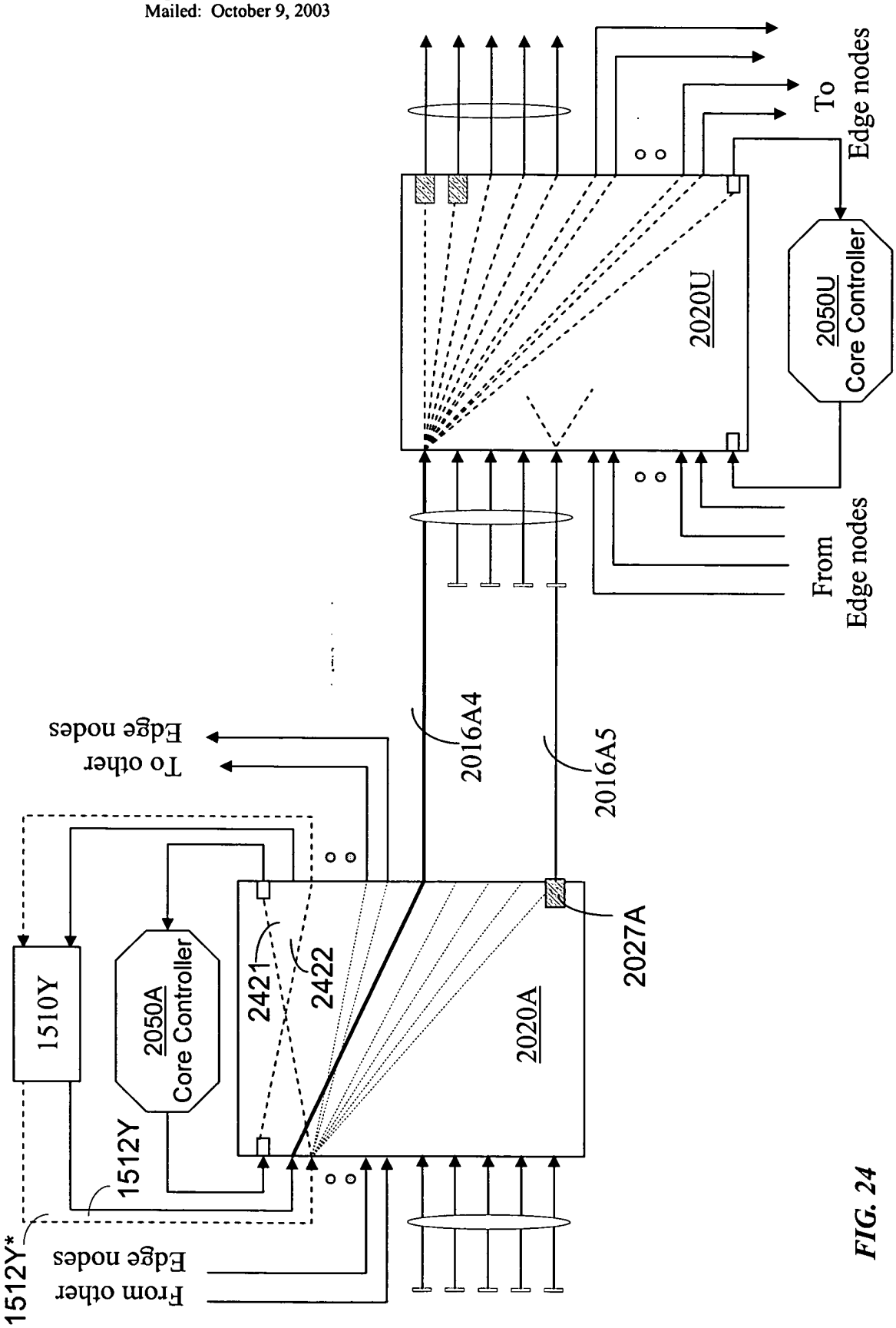

To Edge nodes
2050U Core Controller
2020U
From Edge nodes
2016A4
2016A5
To other Edge nodes
2027A
2421
2422
2020A
2050A Core Controller
1510Y
1512Y
1512Y*
From other Edge nodes

FIG. 24

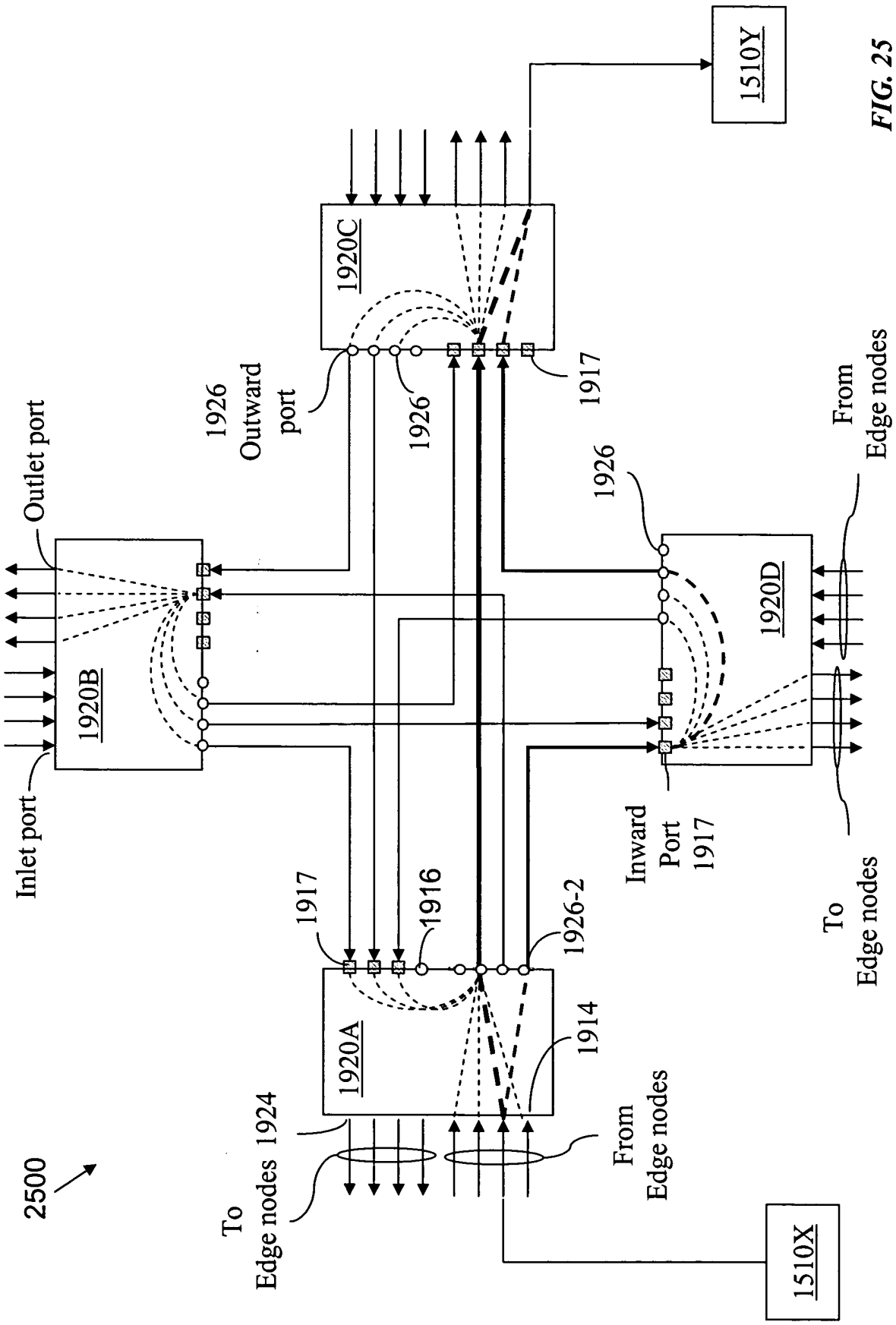

2500
1920A
1920B
1920C
1920D
1510X
1510Y
Inlet port
Outlet port
1926
Outward port
1926
1926
1926-2
1916
1917
1917
1917
1914
Inward Port 1917
From Edge nodes
From Edge nodes
To Edge nodes 1924
To Edge nodes

FIG. 25

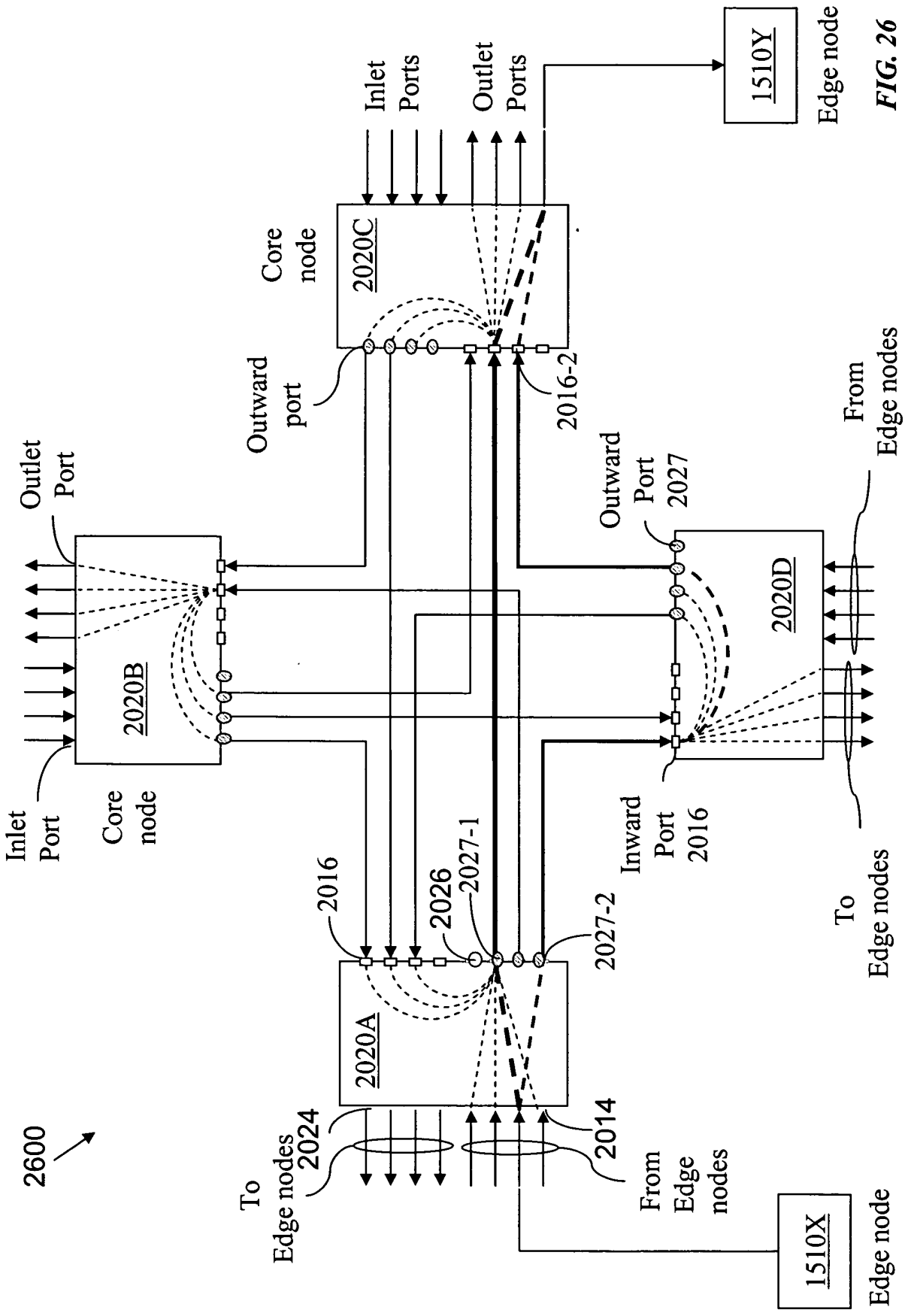

2600
2020A
2020B
2020C
2020D
1510X
Edge node
1510Y
Edge node
Core node
Core node
Core node
Core node
Inlet Ports
Outlet Ports
Inlet Port
Outlet Port
Outward port
Outward Port 2027
Inward Port 2016
2016-2
2016
2026
2027-1
2027-2
2014
2024
From Edge nodes
To Edge nodes
From Edge nodes
To Edge nodes

FIG. 26

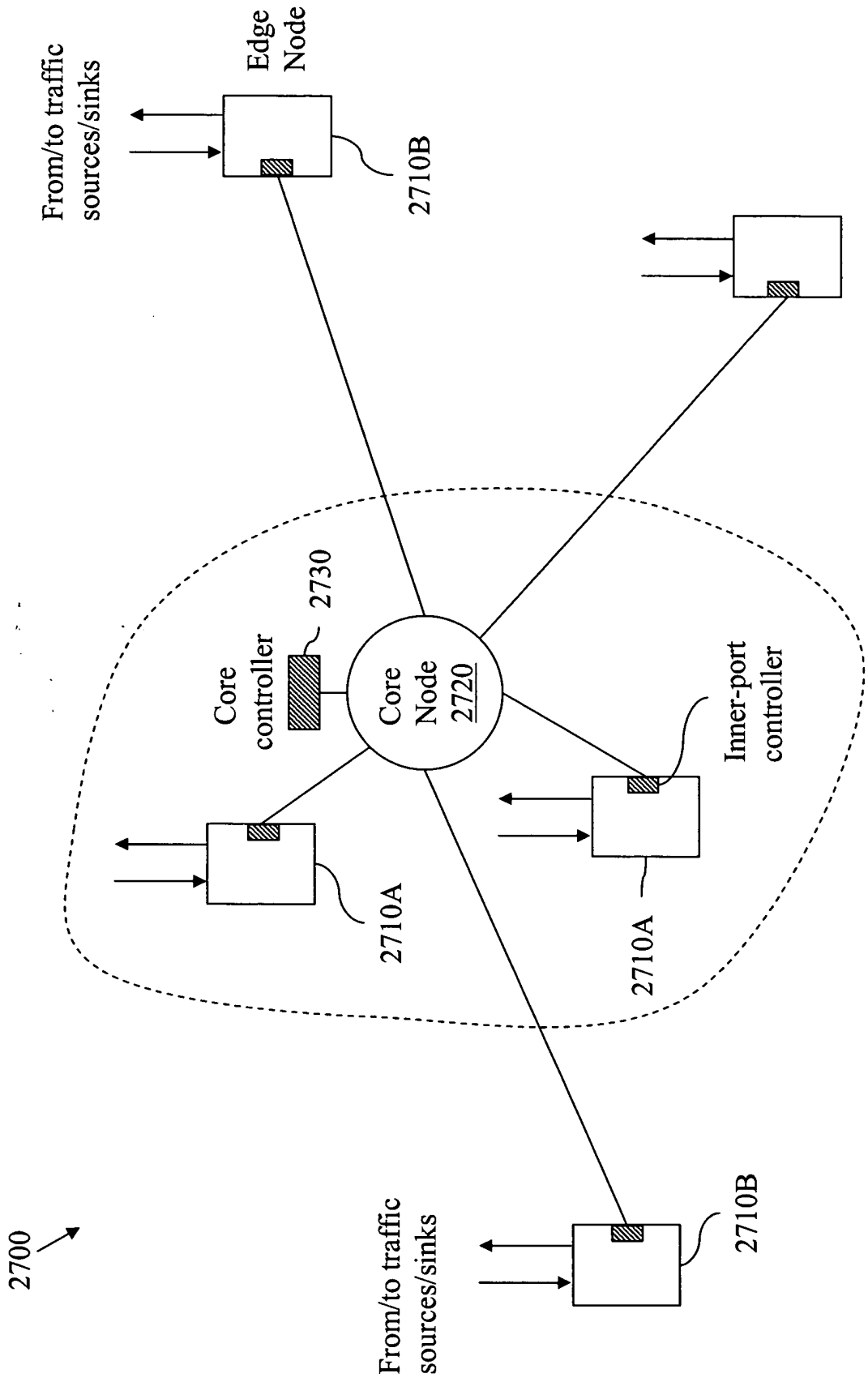

2700
From/to traffic sources/sinks
Edge Node
2710B
Core controller
2730
Core Node 2720
Inner-port controller
2710A
2710A
From/to traffic sources/sinks
2710B

FIG. 27

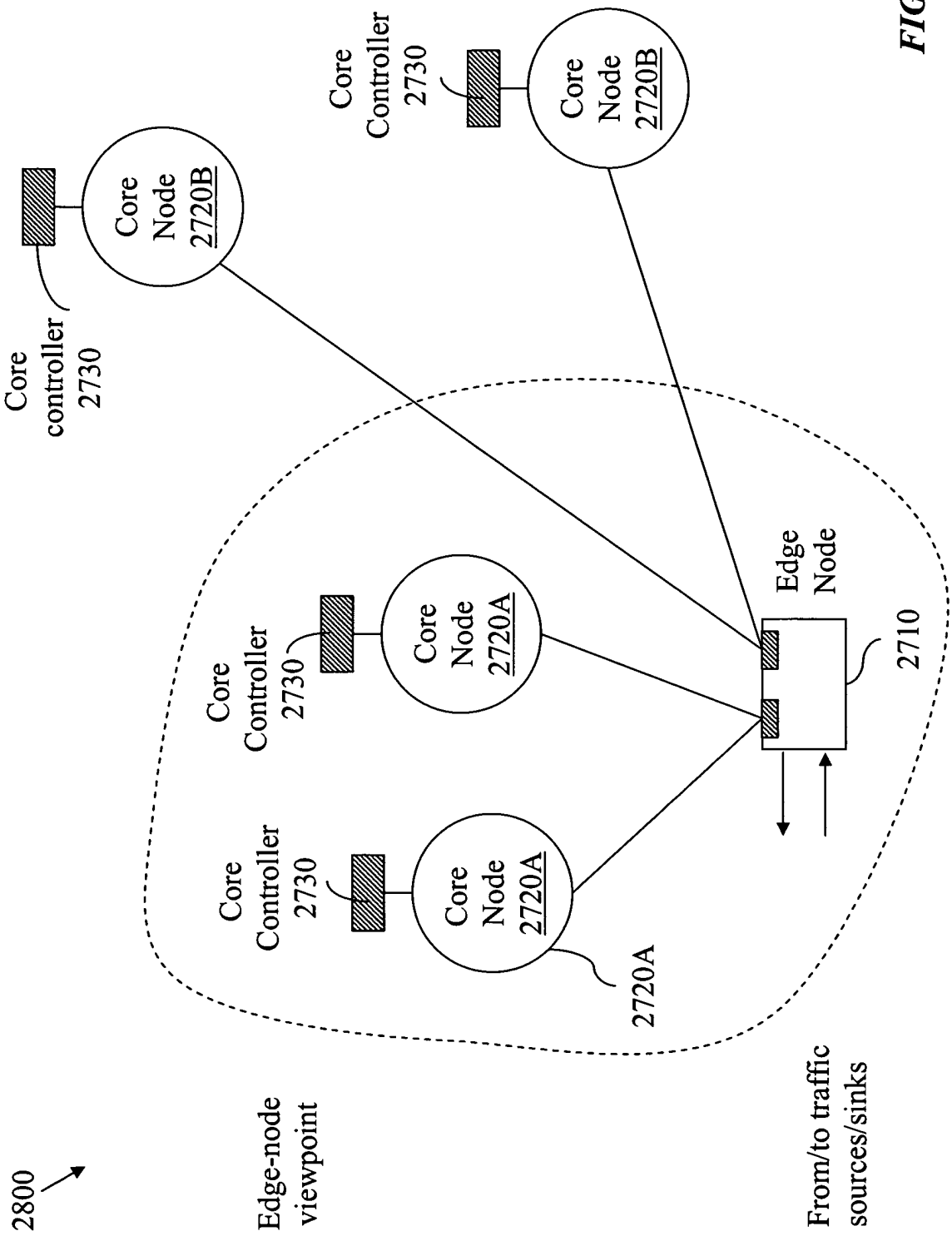

2800
Edge-node viewpoint
From/to traffic sources/sinks
Core controller 2730
Core Node 2720B
Core Controller 2730
Core Node 2720B
Core Controller 2730
Core Node 2720A
Core Controller 2730
Core Node 2720A
2720A
Edge Node
2710

FIG. 28

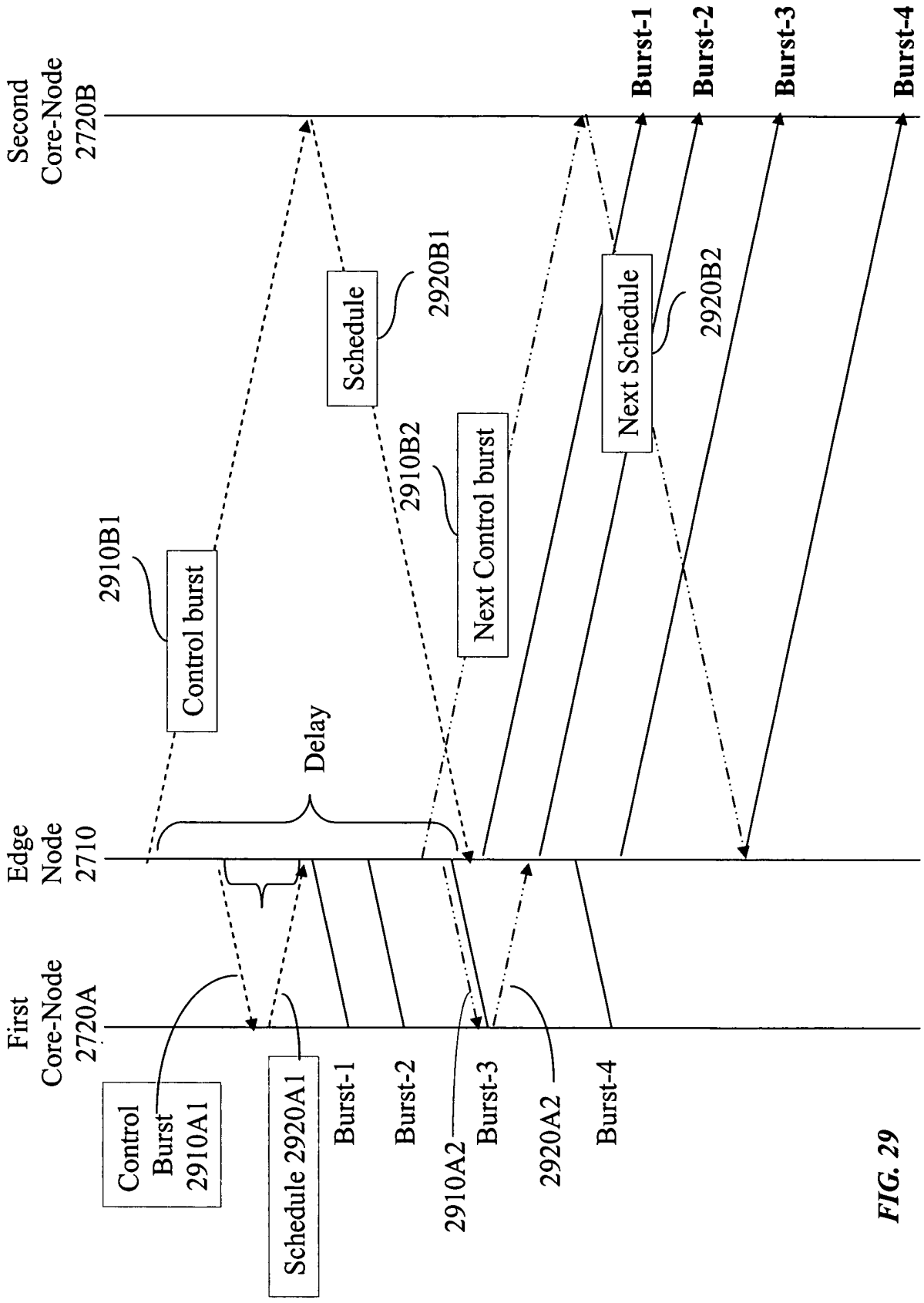

Second Core-Node 2720B
Edge Node 2710
First Core-Node 2720A
Burst-1
Burst-2
Burst-3
Burst-4
2910B1
Control burst
Delay
Schedule
2920B1
2910B2
Next Control burst
Next Schedule
2920B2
Control Burst 2910A1
Schedule 2920A1
Burst-1
Burst-2
2910A2
Burst-3
2920A2
Burst-4

FIG. 29

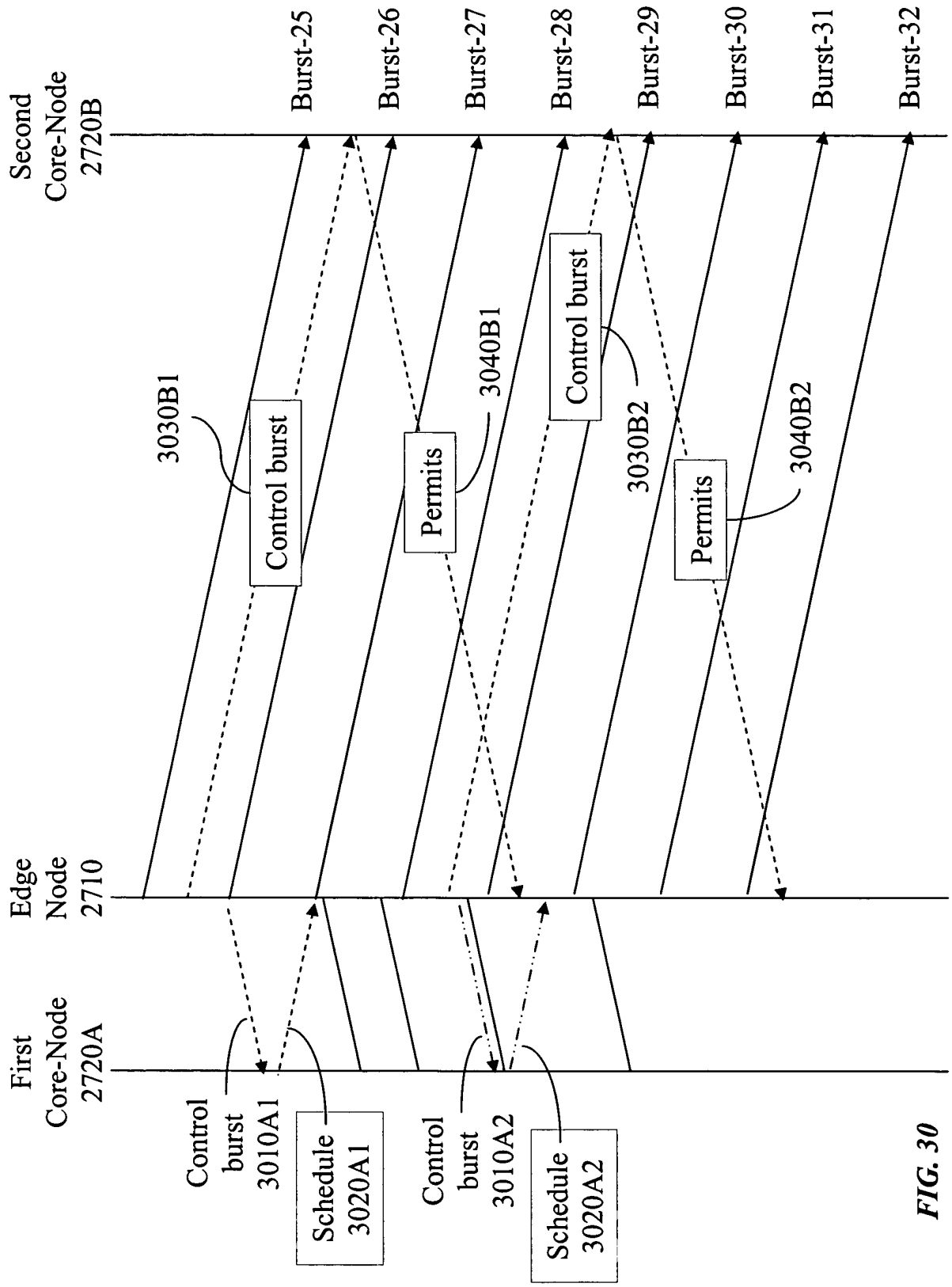

First Core-Node 2720A
Edge Node 2710
Second Core-Node 2720B
Control burst 3010A1
Schedule 3020A1
Control burst 3010A2
Schedule 3020A2
3030B1
Control burst
Permits
3040B1
3030B2
Control burst
Permits
3040B2
Burst-25
Burst-26
Burst-27
Burst-28
Burst-29
Burst-30
Burst-31
Burst-32

FIG. 30

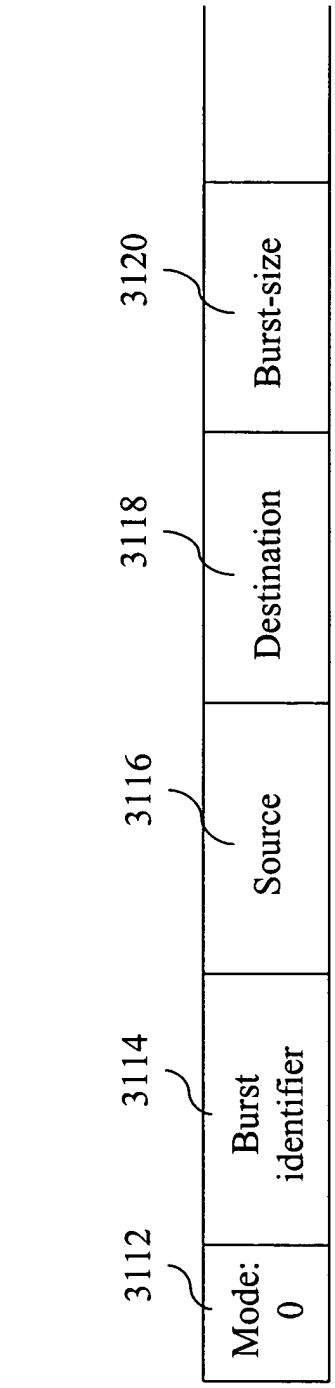


FIG. 31A

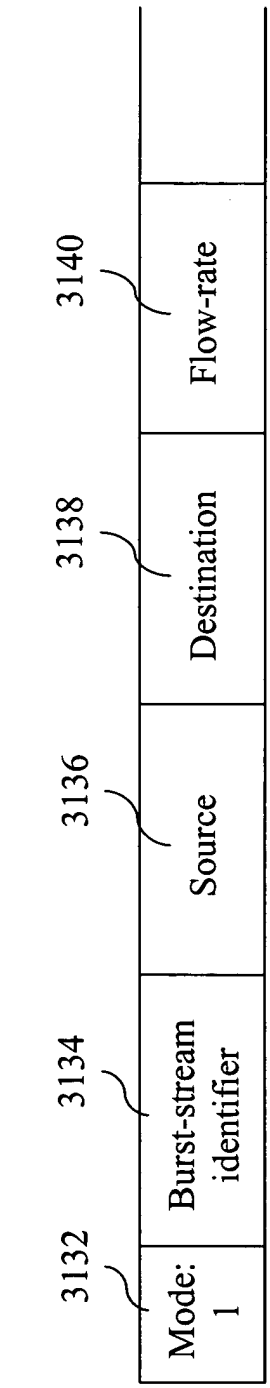


FIG. 31B

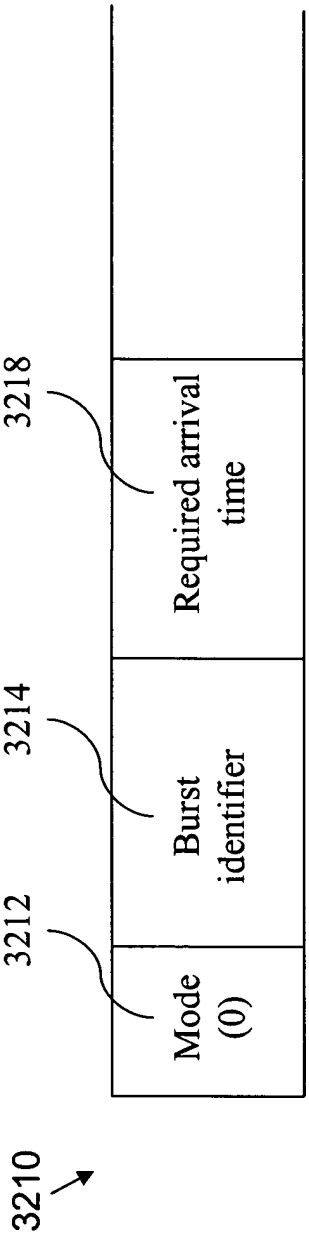


FIG. 32A

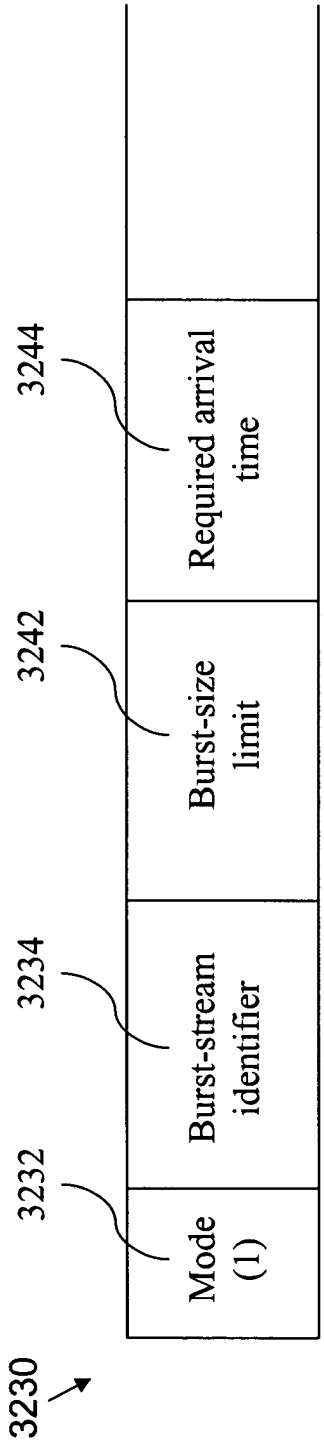


FIG. 32B

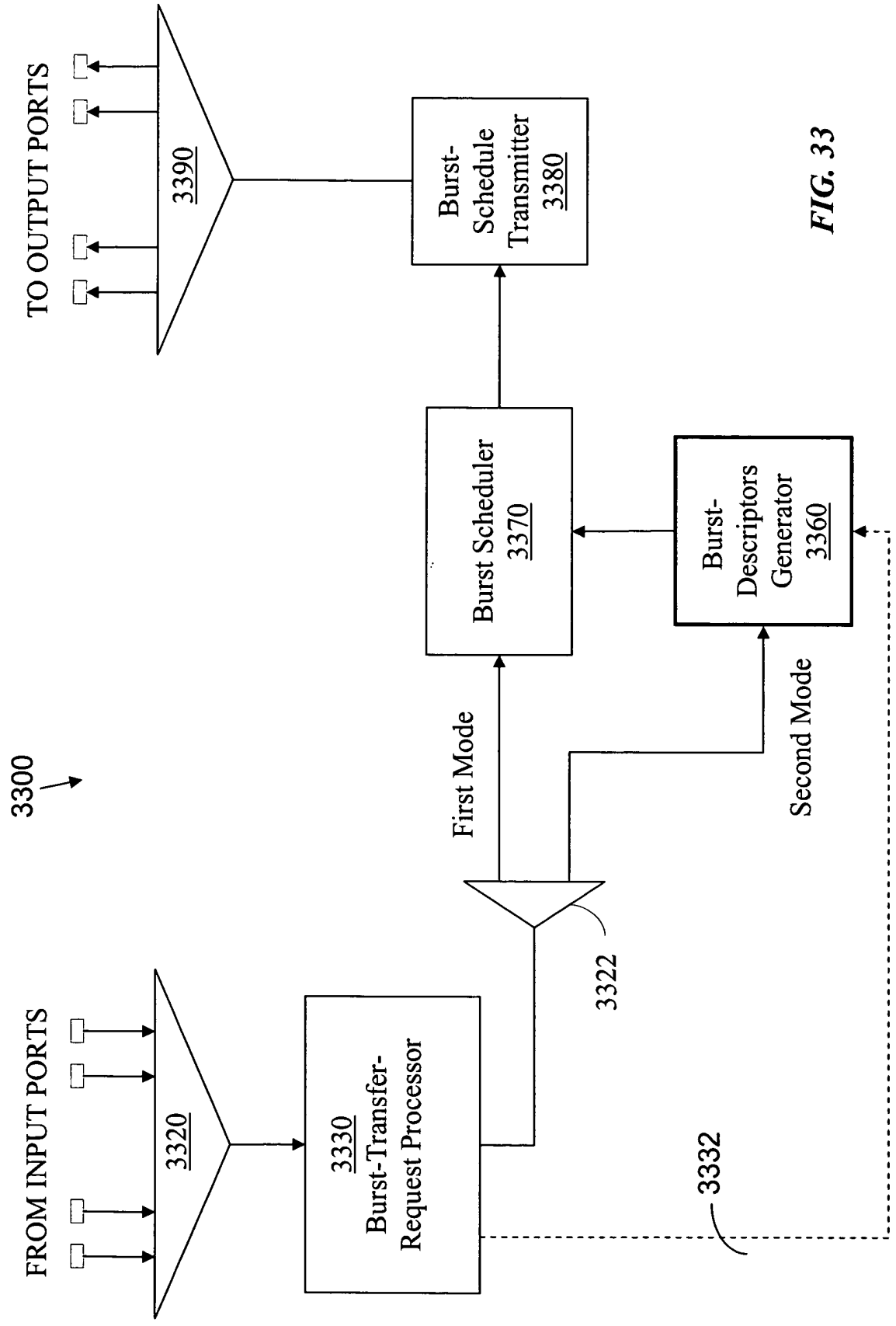

TO OUTPUT PORTS
3390
Burst-Schedule Transmitter 3380
Burst Scheduler 3370
Burst-Descriptors Generator 3360
3300
First Mode
Second Mode
3322
FROM INPUT PORTS
3320
3330 Burst-Transfer-Request Processor
3332

FIG. 33

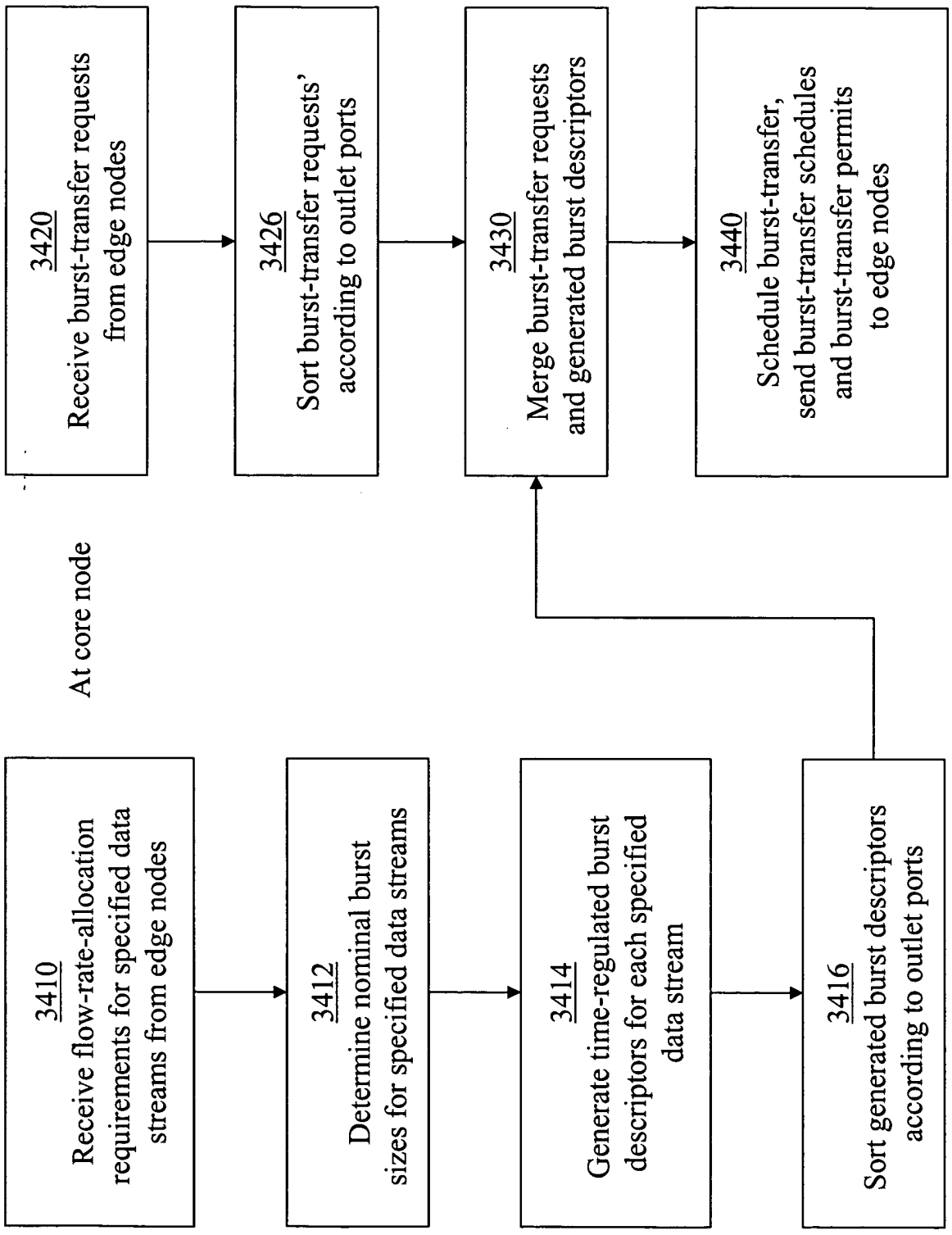

3410
Receive flow-rate-allocation requirements for specified data streams from edge nodes
3412
Determine nominal burst sizes for specified data streams
3414
Generate time-regulated burst descriptors for each specified data stream
3416
Sort generated burst descriptors according to outlet ports
At core node
3420
Receive burst-transfer requests from edge nodes
3426
Sort burst-transfer requests' according to outlet ports
3430
Merge burst-transfer requests and generated burst descriptors
3440
Schedule burst-transfer, send burst-transfer schedules and burst-transfer permits to edge nodes

FIG. 34

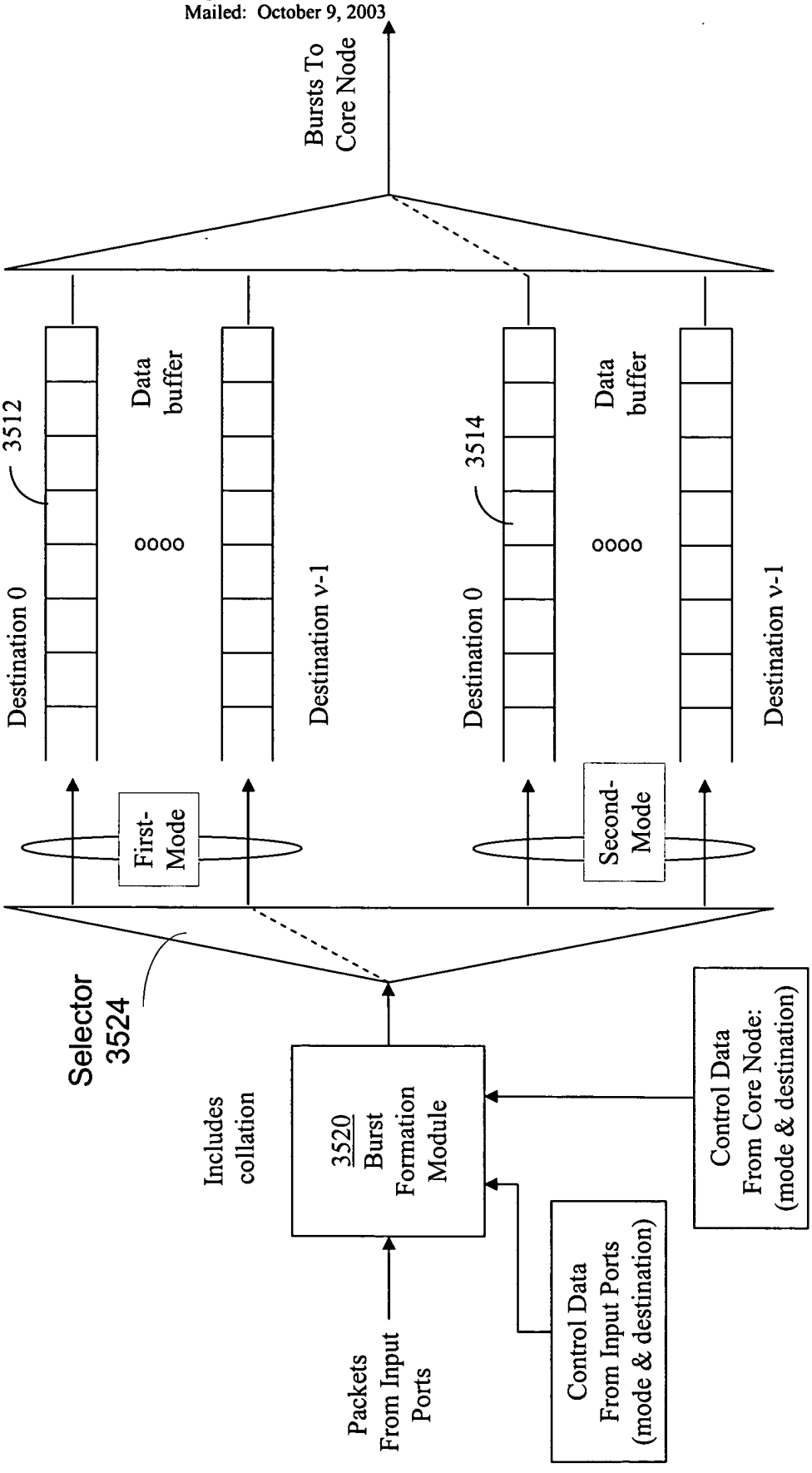

Bursts To Core Node
Data buffer
3512
Destination 0
oooo
Destination v-1
3514
Destination 0
Data buffer
oooo
Destination v-1
First-Mode
Second-Mode
Selector 3524
Includes collation
3520 Burst Formation Module
Control Data From Core Node: (mode & destination)
Packets From Input Ports
Control Data From Input Ports (mode & destination)

FIG. 35

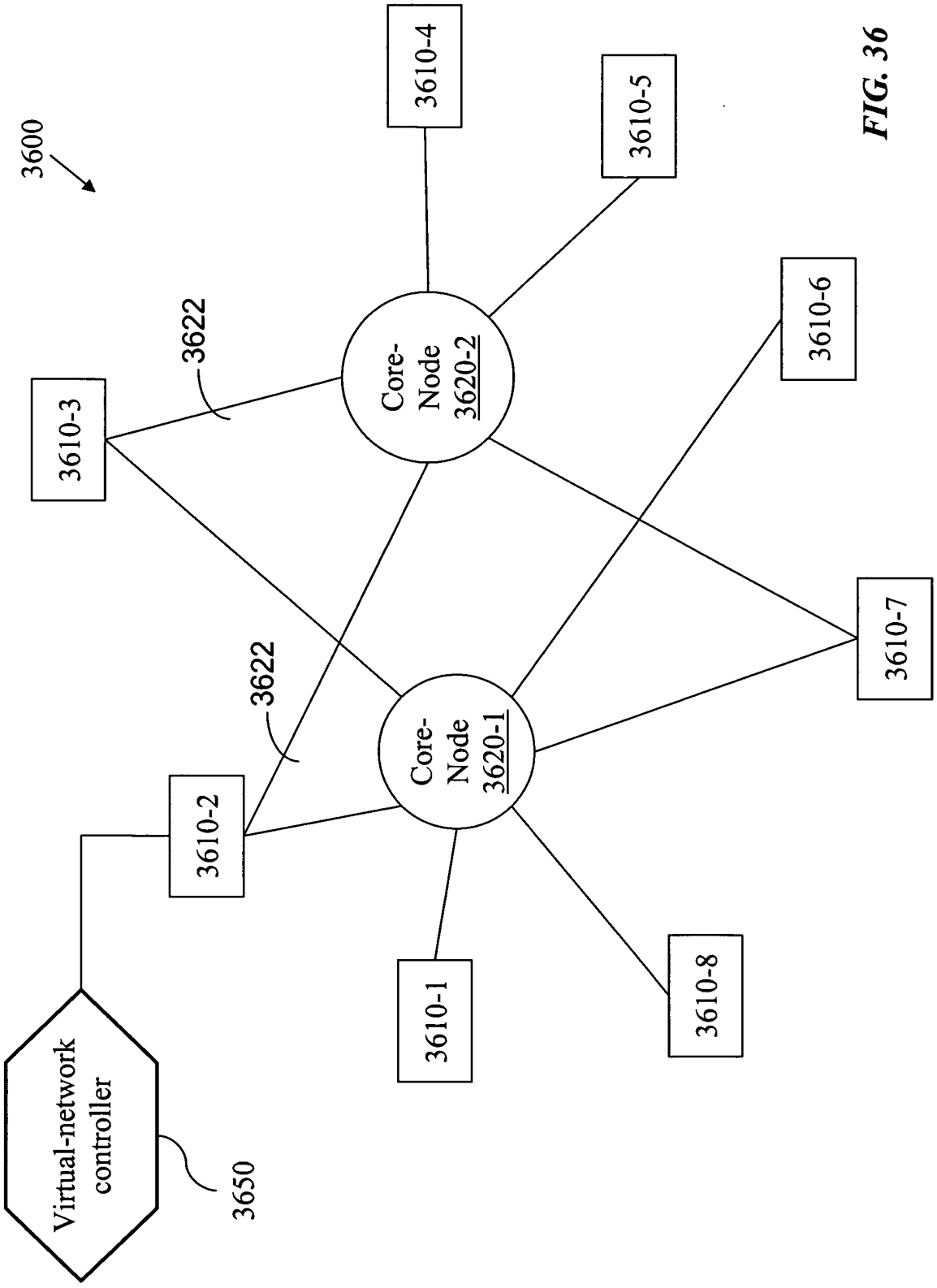

3600
3610-4
3610-5
3610-6
3610-7
3610-8
3610-1
3610-2
3610-3
3622
3622
Core-Node 3620-2
Core-Node 3620-1
Virtual-network controller
3650

FIG. 36

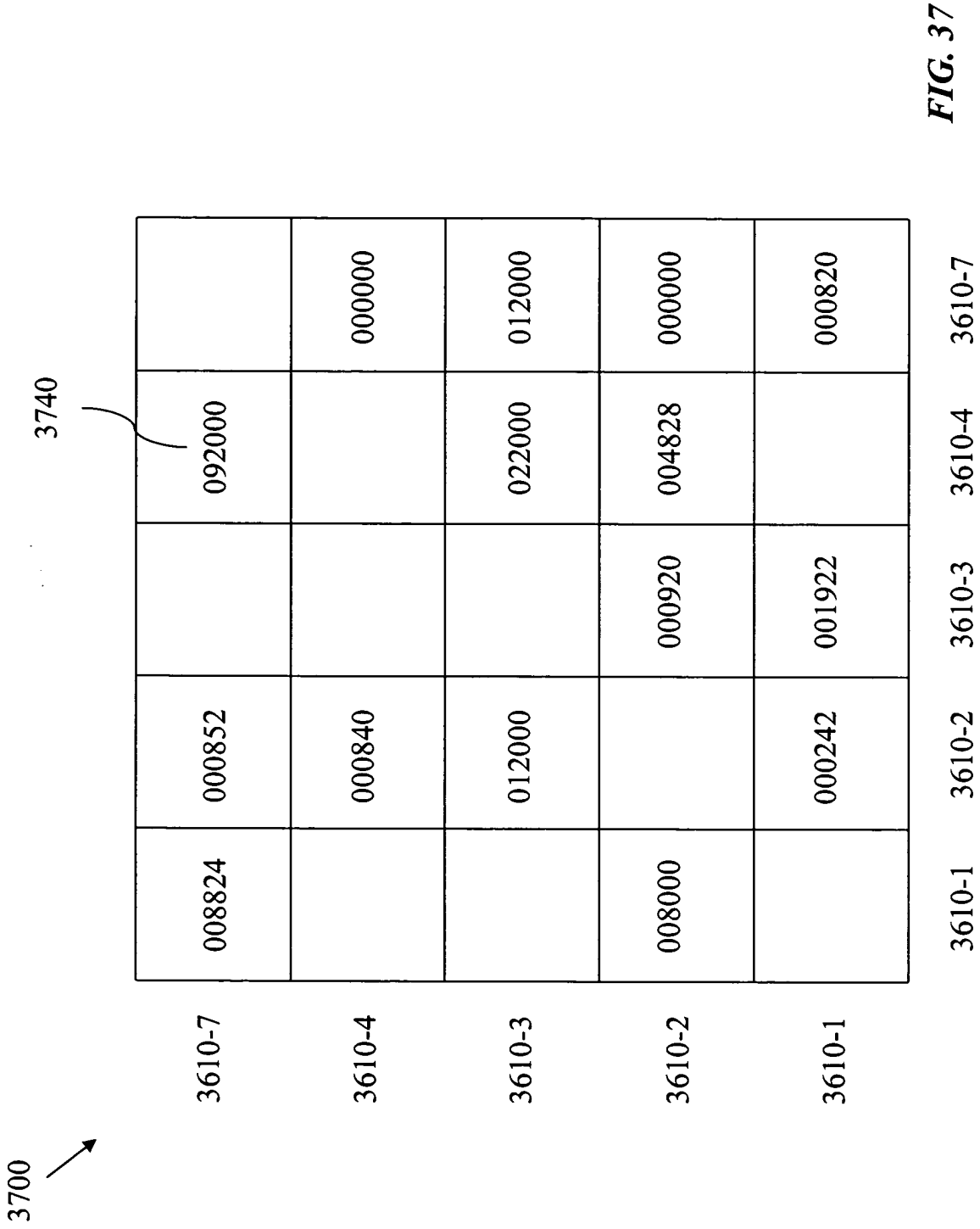

3700
3740
3610-7
3610-4
3610-3
3610-2
3610-1
008824
000852
092000
000000
000840
000000
012000
012000
022000
000000
008000
000920
004828
000000
000242
001922
000820

FIG. 37

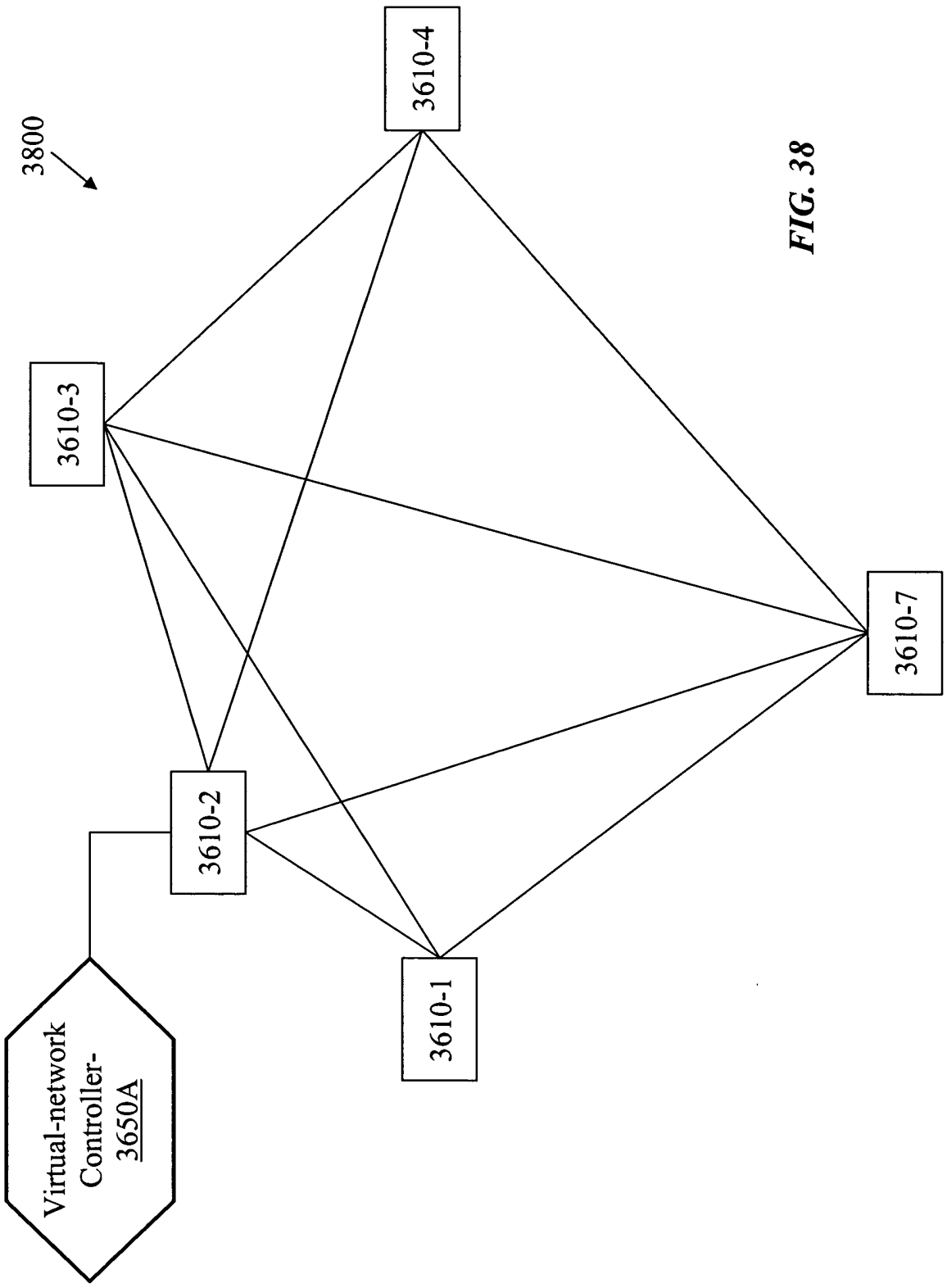

3800
3610-4
3610-3
3610-7
3610-2
3610-1
Virtual-network Controller- 3650A

FIG. 38

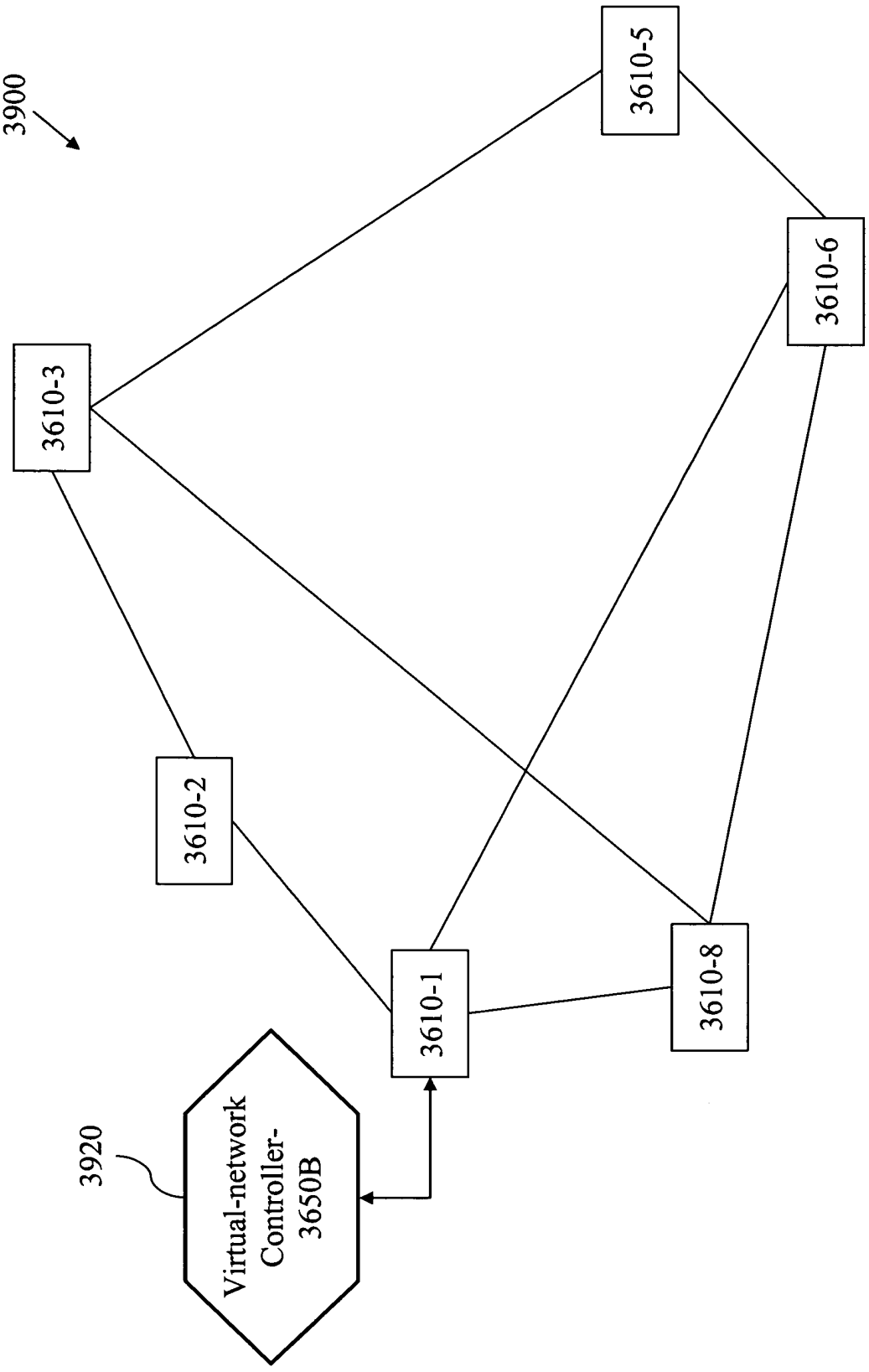

3900
3610-5
3610-6
3610-3
3610-2
3610-1
3610-8
3920
Virtual-network Controller-3650B

FIG. 39

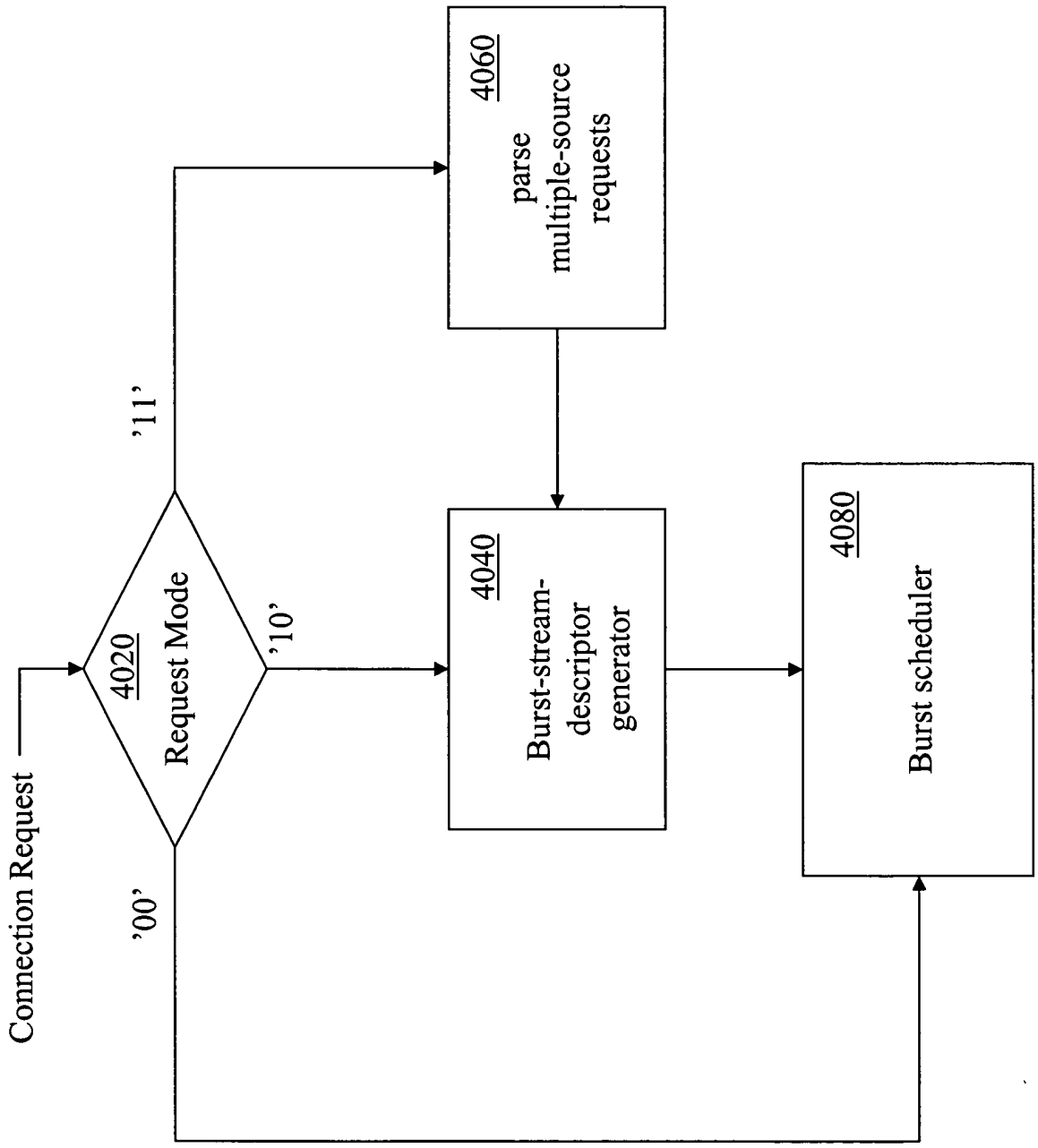

Connection Request
4020
Request Mode
'00'
'10'
'11'
4040
Burst-stream-descriptor generator
4060
parse multiple-source requests
4080
Burst scheduler

FIG. 40

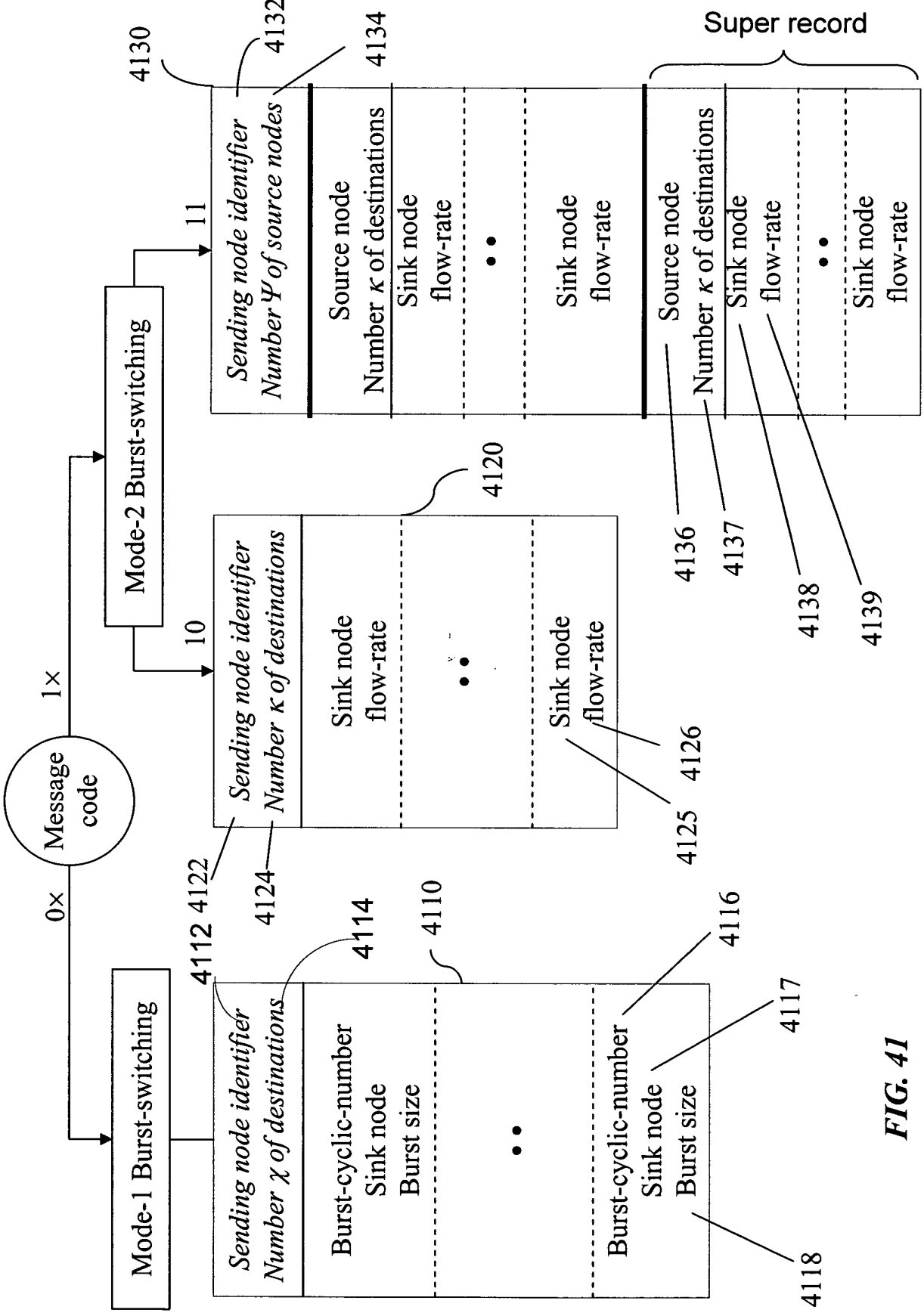

Message code
1×
0×
Mode-1 Burst-switching
Mode-2 Burst-switching
11
10
4130
4132
4134
Sending node identifier
Number Ψ of source nodes
Source node
Number κ of destinations
Sink node
flow-rate
Sink node
flow-rate
Super record
4120
Sending node identifier
Number κ of destinations
Sink node
flow-rate
Sink node
flow-rate
4122
4124
4125
4126
4136
4137
4138
4139
4112
4114
4110
4116
4117
4118
Sending node identifier
Number χ of destinations
Burst-cyclic-number
Sink node
Burst size
Burst-cyclic-number
Sink node
Burst size

FIG. 41

Sending node 3610-2
Number of source nodes 4
Source node 3610-1
Destinations 3
Sink node 3610-2
Flow rate 000242
Sink node 3610-3
Flow rate 001922
Sink node 3610-7
Flow rate 000820
Source node 3610-2
Destinations 2
Sink node 3610-3
Flow rate 000920
Sink node 3610-7
Flow rate 000000
Source node 3610-3
Destinations 1
Sink node 3610-2
Flow rate 012000
Source node 3610-7
Destinations 1
Sink node 3610-1
Flow rate 008824

FIG. 42A

Sending node 3610-2
Number of source nodes 4
Source node 3610-2
Destinations 3
Sink node 3610-1
Flow rate 008000
Sink node 3220-4
Flow rate 004828
Source node 3610-3
Destinations 2
Sink node 3610-4
Flow rate 022000
Sink node 3610-7
Flow rate 012000
Source node 3610-4
Destinations 2
Sink node 3610-2
Flow rate 000840
Sink node 3610-7
Flow rate 000000
Source node 3610-7
Destinations 2
Sink node 3610-2
Flow rate 000852
sink node 3610-4
Flow rate 092000

FIG. 42B